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DOMESTIC ECONOMY

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Sec. I. HUMAN PHYSIOLOGY (Elements of).

By Walker Overend, B.A. (Oxon.), B.Sc. (Lond.), Late Scholar of Balliol College and Radcliffe Travelling Fellow.

Sec. II. DOMESTIC HYGIENE.

By Elizabeth J. Moffitt, B.Sc. (Lond.)

Sec. III. PREPARATION OF FOOD FOR THE SICK.

By Alfred Carpenter, M.D., D.P.H. Examiner to the London and Cambridge Universities.

Sec. IV. PLAIN COOKERY.

By Mrs. B. W. Gothard. Gold Medallist in Cookery, &c.

Sec. V. CLOTHING AND LAUNDRY WORK.

By Miss Mann. Lecturer at the Domestic Economy Training School, Liverpool.

Sec. VI. HOUSEHOLD MANAGEMENT, EXPENSES, AND INVESTMENTS.

By Mrs. Burgwin. Member of the Executive, National Union of Teachers; Head Mistress Orange Street Board School, Southwark.

Sec. VII. HOW TO MAKE THE HOME PRETTY.

By May Morris.

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PUBLISHER'S NOTE.

THOUGH primarily designed for Pupil Teachers, Students in Training, and Schoolmistresses, I am not without hope that this volume may prove useful to the intelligent housewife.

My aim has been the rather to provide a liberal education on the subject than to put into the hands of young teachers a book that barely meets the examination requirements of the Education Department.

To this end I have entrusted the various sections to acknowledged experts.

The section entitled 'The Elements of Human Physiology' has been included owing to the recommendation of the Royal Commission on Education.

In sending forth this volume, I desire to express my deep obligations to those authors who, at considerable personal inconvenience, have most generously come to my help.

JOSEPH HUGHES.

PILGRIM STREET, LUDGATE HILL.
January 15th, 1891.

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Section I.

ELEMENTS OF HUMAN PHYSIOLOGY.

BY

WALKER OVEREND, B.A. (Oxon.), B.Sc. (Lond.),

Late Scholar of Balliol College, and Radcliffe Travelling Fellow.

Deputy Lecturer on Physiology at St. George's Hospital, London, W.

ELEMENTS OF HUMAN PHYSIOLOGY.

CHAPTER I.

INTRODUCTION.

1. The study of Physiology includes the manifestations of life as presented by the vegetable as well as the animal world. Here we shall limit ourselves, however, to the study of Human Physiology. The body of man obviously consists of a number of parts or **organs**; it is, therefore, said to be organised. Each organ has some special office or use assigned to it; this is termed its **function**. Thus the lungs are the organs of breathing, or respiration; the teeth are the organs of mastication; the eye is the organ of sight; while the function of the heart is that of circulation—the distribution of the blood over the various parts of the body, in order to supply them with nourishment.

2. Before we commence the proper study of the functions of these several organs, it is necessary to have a definite idea of their arrangement and connections with each other. This is taught us by the science of **Anatomy**. One branch of Anatomy, called **Histology**, busies itself with the appearances

of the organs, as shown by the magnifying powers of the microscope, in other words, with the **structure** of the organ.

3. The simple structures are termed **tissues**. Thus we have bone or osseous tissue, muscle or muscular tissue, nervous tissue, and the like. An organ is not necessarily made up entirely of one kind of tissue. An ordinary muscle of the body, for instance, contains muscular tissue, nerves, blood vessels, and a structure which binds these several parts closely and completely together, termed **connective tissue**.

4. The **organs** may be grouped together to form systems. Thus the functions of digestion are presided over by the digestive system of organs, including the teeth, salivary glands, stomach, and intestines. Of these systems we may enumerate several, thus :—

1. **The motor organs**, including the bones and the muscles which move them.
2. **The digestive organs**, already mentioned.
3. **The lymphatic system**, or the organs of absorption.
4. **The heart and vessels** forming the organs of circulation.
5. **The respiratory system**, including the lungs.
6. **The organs of excretion**, including the skin and kidneys.
7. **The nervous system**, including the brain and spinal cord, with the nerves and organs of sense.

CHAPTER II.

THE CHEMISTRY OF THE BODY.

5. The earth itself, and all that therein is, has been shown by chemistry to be composed of a certain number of simple bodies or **elements** as they have been termed. All substances are made up, therefore, of one or more of these elements. The diamond, for instance, is almost pure carbon. Water is not a simple substance, but consists of the two elements—hydrogen and oxygen. The human body itself contains fourteen elements variously combined. Of these fourteen there are four which are the most important, namely, oxygen, nitrogen, carbon, and hydrogen.

6. **Oxygen**, as obtained in a pure state, is a transparent and invisible gas. In combination with hydrogen it forms the water we drink; mixed with nitrogen, it constitutes the air we breathe, and forms the most important element of the air, since, when absent, suffocation at once follows. It is usually prepared by heating red precipitate, or oxide of mercury, or by heating chlorate of potassium mixed with oxide of manganese. On plunging a taper into a jar containing oxygen the taper burns much more brilliantly than in air, but the oxygen itself does not burn; that is, while it **supports combustion** much better than air, like air, it is not inflammable. All substances such as sulphur, wood, &c., which burn in air, burn with increased brilliancy and rapidity in oxygen. It can be respired when pure, and supports life; hence, it was called **vital air.** Water takes up a certain amount of oxygen from the air, and this meets the requirements of such aquatic animals as do not come to the surface to breathe. The chemical symbol is O.

7. **Hydrogen** (symbol H), is one of the elements of water,

hence its name. When strips of zinc are added to a solution of hydrochloric acid, a gas is given off from the surface of the liquid, which is hydrogen. It is a colourless gas, exceedingly light, being sixteen times lighter than oxygen. When a light is put to it the gas burns with a blue flame, and at the same time, combining with the oxygen of the air, produces water.

8. **Carbon** (symbol C), is a solid element which may exist in several forms. The **soot** deposited on the ceiling by a smoky lamp, the light porous **charcoal** prepared from wood, **black lead** used in the manufacture of pencils, and the hard and brilliant **diamond** are all forms of carbon. Carbon has a powerful attraction for oxygen, and when charcoal is burnt in air carbonic acid is the result.

9. **Nitrogen** (symbol N), is one of the elements of air, and may be obtained from it by removing the other element—oxygen. Out of every 100 parts of the atmosphere there are 79 nitrogen and 21 oxygen. The oxygen may be removed by burning a small piece of phosphorus in a closed space of air. Nitrogen is a colourless gas which will neither burn itself nor will it support combustion; in other words, a lighted taper is at once extinguished on being plunged into a jar containing nitrogen. Nitrogen is the essential constituent of flesh, of nerve, and of the blood. Animals quickly die in it from a want of oxygen.

10. **The air** we breathe is a mixture of the gases **nitrogen** and **oxygen** in the proportions we have already mentioned. The presence of nitrogen serves to moderate all chemical actions which depend on the activity of the oxygen. **Carbonic acid** is also present in the air to a slight extent, about four parts in every 10,000 parts of air.

11. **Water** is a chemical compound containing **hydrogen and oxygen** in the proportions H_2O. Any substance which possesses a greater attraction for the oxygen will unite with the latter and set the hydrogen free. Thus sodium, when placed on water, decomposes it. Water freezes and becomes ice at

the freezing point (0° Centigrade; 32° Fahrenheit), and boils at 100° Centigrade, that is 212° Fahrenheit.

12. **Ammonia** is a gas with a strong pungent smell, which readily dissolves in water, forming a solution of ammonia as sold by the chemist. Red litmus paper is turned blue by this solution. Such bodies as turn red litmus blue are termed **alkalis** or **bases**. Among these also are **potash** and **soda**. Other bodies turn blue litmus red, and are termed **acids**, for instance, hydrochloric, sulphuric, and nitric acids. Whenever animal matter, as **bone, hair, flesh**, is burnt or decays, a certain amount of ammonia is produced. Ammonia contains the elements nitrogen and hydrogen in the proportion of 1 to 3, hence its symbol or chemical formula is NH_3.

13. **Carbonic acid**, or Carbon dioxide (CO_2) is the gas contained in effervescing drinks. In the case of soda water the gas is pumped into it under pressure, and the bottle tightly corked. When the cork is withdrawn, the gas is given off again, and produces the well-known appearance. Carbonic acid is **heavier** than air and oxygen. It can be readily prepared by placing bits of **marble or chalk** in a tumbler, and pouring over them some **hydrochloric acid.** After a few minutes, plunge a taper into the space in the tumbler above the liquid, and it will be extinguished, showing that carbonic acid neither supports combustion, nor does it burn. It is largely present in the air we breathe out. A simple experiment proves this: thus, if a small glass tube be dipped into a solution of lime water (CaO) and one blows a few minutes down the tube, the expired air bubbles through the lime water, and a cloudiness or precipitate is produced, since the carbonic acid of the breath has combined with the lime water, and has produced carbonate of lime ($CaO + CO_2 = CaCO_3$). This is our original marble or chalk, since both marble and chalk consist of the same compound, carbonate of lime.

14. **Carbonate and phosphate of lime** are both constituents of **bone.** If bone be burnt in the fire there is

often left behind a model or cast of the bone in ash, which consists of carbonate and phosphate of lime, there being about three times as much phosphate of lime as carbonate. Bone also contains animal matter as well as mineral matter. The fire in the above experiment has destroyed the animal and left the mineral substances. If the thigh bone of a rabbit be placed in dilute nitric acid (aqua fortis), and left for a few days, it is found to have become quite soft, and is easily bent. In other words, the nitric acid has dissolved the salts (carbonate and phosphate of lime) out of the bone (which rendered it hard) and left the gelatin, which is soft and flexible.

15. Among the most important bodies found in the body are **proteids, starch, sugar, fats, urea** and **uric acid** with **mineral matters. Proteids** are substances of the most vital importance to animals and man. They contain the elements—nitrogen, carbon, oxygen, hydrogen, and sulphur, in these proportions, N = 15 per cent.; carbon, 54; oxygen, 23; hydrogen, 7, and sulphur, 1 per cent. All proteids are turned yellow by nitric acid. They include:—

1. **The albumin** present in the white of egg. The albumin present in blood is termed serum-albumin.
2. **Globulin,** present also in blood, and here called **Paraglobulin**; also in muscle, where it is called **Myosin**; and as **Fibrinogen**, which is also present in blood. All the albumins and globulins are coagulated (or thickened) by warming to a certain temperature; but the albumins are soluble in water, the globulins not so.
3. **Acid albumin** is produced by the action of weak acids on albumin or globulin. When myosin is treated with acids, the acid albumin produced is termed **syntonin.**
4. **Alkali-albumin**, produced by the action of potash on albumin. **Casein** is an alkali-albumin present in milk and cheese.

5. **Peptones** are bodies formed by the action of the juices of the stomach and pancreas on albumin or globulin. They are soluble in water (unlike acid and alkali-albumin), but they are not coagulated by heat, just as acid and alkali-albumin are not. Moreover, peptones have the power of passing readily through the walls of the stomach, so as to enter the blood.

6. **Other substances** present in the body resemble proteids in some of their properties, but not in all. Such are the **gelatin** of the bones, which is soluble in hot water, but forms a jelly on cooling; and **chondrin**, which is obtained from **cartilage** or **gristle**.

16. When the stomach of a freshly killed dog, rabbit, or cat, is removed from the body, and the contents washed out, the lower end then tied, and a solution of white of egg mixed with common salt is placed inside, the upper end then tied, and the whole placed in water, it is found that the salt passes readily through, while the white of egg (albumin) passes through very slowly and with great difficulty. In other words proteids **diffuse badly through animal membranes.** Peptones are the only proteids which diffuse readily.

17. The **fats, starches**, and **sugars** all contain the same elements—carbon, hydrogen, and oxygen; but in the starches and sugars these two latter elements are present in the same proportions as in water, thus the chemical formula of starch is $C_6H_{10}O_5$, while there is a deficiency of oxygen in fats. These three substances are called non-nitrogenous bodies. Ordinary fat contains stearin, palmitin, and olein, of which the last, when separated from the other two, is fluid. When broken up by the action of potash they yield glycerin and an acid, which combines with the potash to form a soap. In the body they suffer decomposition, and leave finally as carbonic acid and water.

18. The **starches** or **amyloids** and **sugars** are present in many vegetable so-called farinaceous foods, as rice, potatoes, tapioca, sago, arrowroot. Starch is the chief constituent of the starch grains of plants. It is soluble in boiling water, and when warmed with dilute acid is converted into sugar. **Glycogen**, a form of starch, occurs in the liver. **Sugar** is found in small quantities in the blood and in the muscles. In milk **lactose**, or milk-sugar, is present.

19. **Urea.**—Proteids, that is, the nitrogenous compounds of the organism, after staying some time in the body, and serving their purpose, are converted finally into **urea**, and **uric acid**, and in this form are excreted by the kidneys and pass into the urine. Urea is a body containing carbon, hydrogen and oxygen, and nitrogen in the following proportions, CON_2H_4. After it leaves the body it is after a time further broken up into carbonic acid and ammonia. About 500 grains (33 grammes), that is about one ounce, of urea is excreted daily. In the urine of dogs it is so abundant that on allowing the urine to stand, urea separates from the liquid as crystals.

Uric acid contains the same elements as urea. It is a less oxidised body. About 7 grains are excreted daily by man. In the urine of reptiles and birds it is present in much larger quantity.

20. Among the **mineral substances** found in the animal frame is common salt, consisting of the two elements—sodium and chlorine. Chlorine, when separated, is a yellow gas, which is very heavy and has bleaching properties. Its symbol is Cl. Hence the symbol for common salt or chloride of sodium is NaCl. Sodium chloride is present in all the fluids of the body, hence the blood and perspiration possess a salt taste. In the blood, six parts in every 1,000 are sodium chloride. When **flesh is burnt** an ash is left behind, which consists of **potash**. Flour, of which bread is made, contains about two per cent. of ash or mineral substance, which is

chiefly sodium chloride. Other mineral or inorganic substance present in the body are **Calcium carbonate** and **phosphate**, especially in the bones. In the young, calcium phosphate is required for the growth of bone, and is present in milk. A certain amount of **Iron salts** exists in the blood and liver. In the **gastric juice**, or fluid secreted by the stomach, there is present hydrochloric acid, the symbol for which is HCl, since it contains the two elements hydrogen and chlorine.

CHAPTER III.

THE ANATOMY OF THE BODY.

21. THE body is divided into **head, trunk,** and **limbs.** Of the latter, the upper limbs are the arms, the lower, the legs. The **head** consists of (1) the **face** with the orbits or cavities which lodge the eyes, the nose, and the upper and lower jaws with the teeth, and of (2) the **cranium** or brain-case, in the interior of which lies the brain. The **trunk** is divided into the **thorax or chest,** and the **abdomen or belly.** The arms are also divisible into the upper arm—reaching as far as the elbow—the fore-arm, and hand. The legs also are made up of the thigh, the leg proper, and the foot.

22. The soft parts of the body consist of the skin, with the hair, of muscles, and of the viscera. At the lips and nostrils the skin becomes continuous with a more delicate layer, called **mucous membrane,** which lines the mouth, gullet, stomach, windpipe, &c. **The skeleton,** which supports these soft parts, contains altogether about 230 separate bones. These are connected with each other by means of joints or **articulations,** and by tough white bands called **ligaments.** The skeleton, like the body, is also divisible into **skull, trunk,** and **limbs** (see fig. 1).

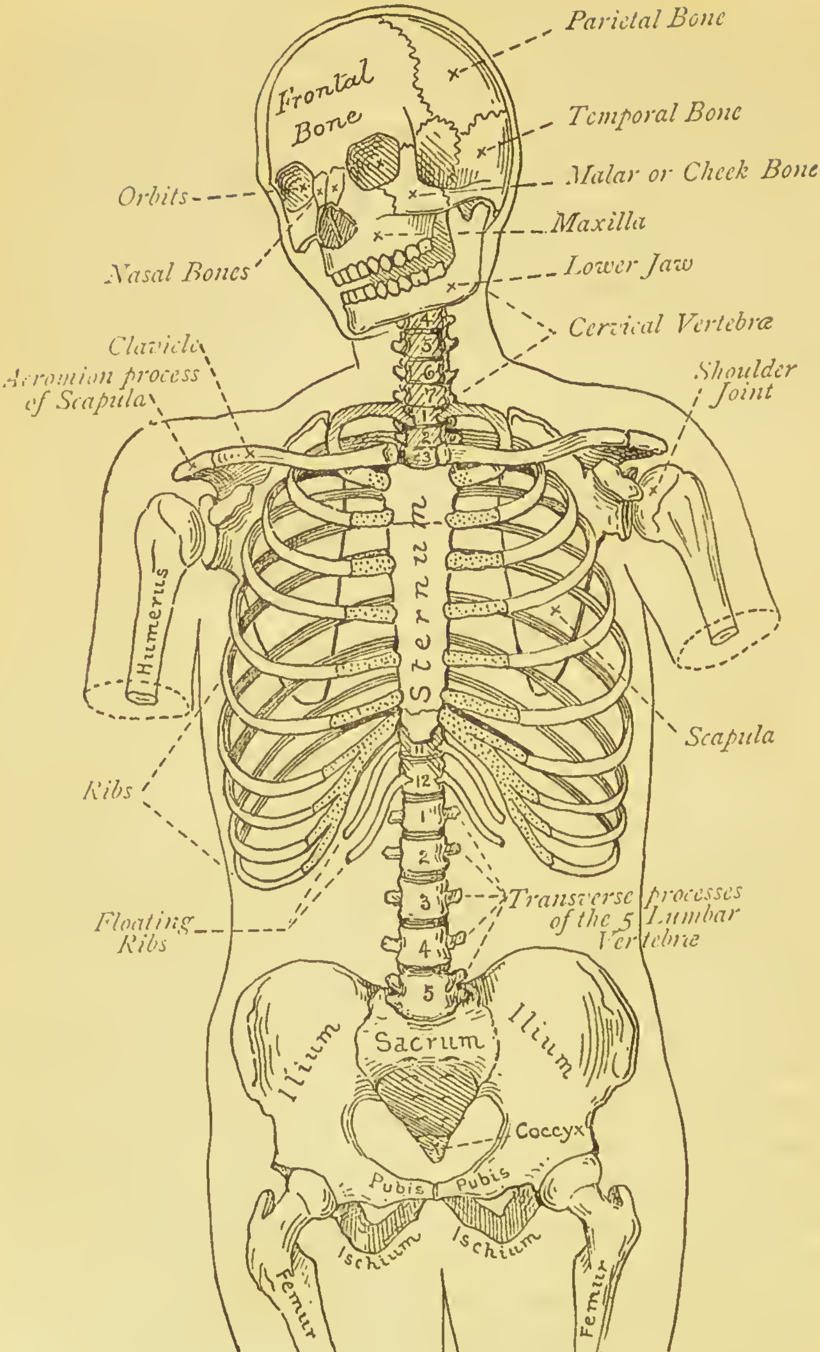

Fig. 1. The Human Skeleton. (The limbs have been shortened to economise space.)

23. The trunk consists of the backbone or vertebral column, made up of 33 distinct bones, called **vertebræ**. Connected with some of these are the **ribs**, which pass around the body, forming hoops, to join with the **sternum** or breast bone, the whole constituting the bony framework of the chest. A typical vertebra, such as one which is connected with the ribs, consists (1) of a **body** (fig. 2), (2) of a **spinous process** or spine, (3) of an **arch** of bone, which forms the roof of a canal

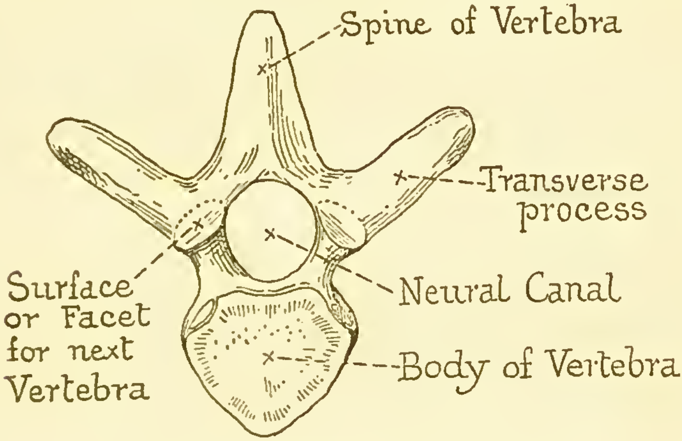

Fig. 2. A Dorsal Vertebra from above.

—neural canal—containing the spinal cord or marrow and its coverings, and (4) the **transverse processes**. Both in front and behind, two small surfaces or facets are visible, by means of which the vertebra fits on to its fellow above and below.

24. The vertebræ are divided into 5 groups—(1) **cervical**, or those of the neck; (2) **dorsal**, in the back; (3) **lumbar**, or those of the loins. Following the last lumbar is (4) the **sacrum**, which consists at first of 5 bones, which afterwards become fused into one. The last portion is (5) the **coccyx**, which is made up of 4 minute vertebræ. The cervical vertebræ are 7 in number. They differ from the dorsal, which are 12 in number, in the fact that no ribs are attached to their bodies and transverse processes. The first two cervical vertebræ have received special names. The first, or **atlas**, is a

mere ring of bone, which possesses two concavities or hollows, in which two convexities or **condyles** (occipital condyles) belonging to the back part of the skull rest. The second is the **axis**, which possesses a process—**odontoid peg.** The lumbar vertebræ are five in number and possess no ribs. They are larger than the dorsal vertebræ. The bodies of the vertebræ do not lie directly upon each other, but a layer of cartilage, called the **inter-vertebral disk**, intervenes. The arches of the vertebræ are united by ligaments consisting of elastic tissue.

25. The **skull** is made up of two portions--(1) the **cranium**, and (2) **the face**. The principal bones of the face are the upper jaw or **maxilla**, the **lower jaw**, the **malar** or cheek bones, the **nasal** bones, and a bone which partly divides the nose into right and left nostrils, called the **vomer**. The **cranium** consists of (1) the **frontal bone** (fig. 1), which forms the forehead and the arches of the orbits, (2) the **two parietal** bones, which lie behind the frontal and form the top of the head, (3) the **occipital** bone, which lies at the back of the head, and (4) the **two temporal** bones, which form the temples and contain the auditory organ in their interior. The **sphenoid** bone (5) forms part of the base of the skull, and the **ethmoid** bone (6) intervenes between the nose and the cranium. On looking at the base of the skull, that is, beneath, many openings or **foramina** are to be seen. The largest is the **foramen magnum** (large opening) in the occipital bone, through which the spinal cord or marrow passes to join the brain. The other smaller foramina serve for blood-vessels passing to the brain, or for nerves passing out from the brain. In a section of the skull the wall is seen

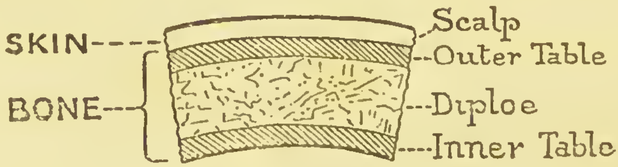

Fig. 3. Section of the Bone of the Skull with skin.

to consist of three layers, an outer and an inner layer of hard bone, called the **tables** of the skull, and of a layer between, which is softer and spongy, called the **diploe** (fig. 3). The bones of the skull are united firmly and immovably together by jagged edges called **sutures**. In fig. 1, notice the suture between the frontal and parietal bones.

26. **The chest or thorax**. The ribs are 12 in number, on each side. Of these, the upper ten pass round from the backbone and unite either directly (upper 7) or indirectly with the sternum or breast bone (fig. 1). They thus form circles or hoops. Near the sternum the bone ceases, and the remainder of the hoop is completed by the **costal cartilages.** In fig. 1 the costal cartilages are represented as granular. The last two ribs are not long enough to reach the sternum, and are called **floating ribs.** The ribs are attached to the **bodies** of the vertebræ as well as their **transverse processes.**

27. **The shoulder and upper limbs.** The shoulder consists of the **clavicle or collar bone**, and the **scapula** or **shoulder-blade**. The scapula has a triangular shape and lies behind the ribs. The surface which touches the ribs is somewhat hollow, while the surface which looks backwards

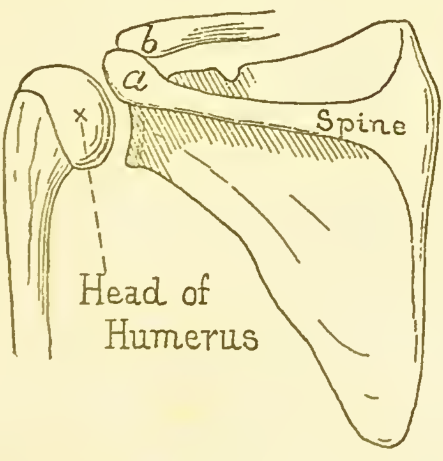

Fig. 4. Back of Right Scapula showing the Spine, ending in *a*, the acromion, which articulates with *b*, the clavicle.

possesses a ridge or **spine**, which at the shoulder-joint enlarges and is called the **acromion**. The **clavicle** passes from the

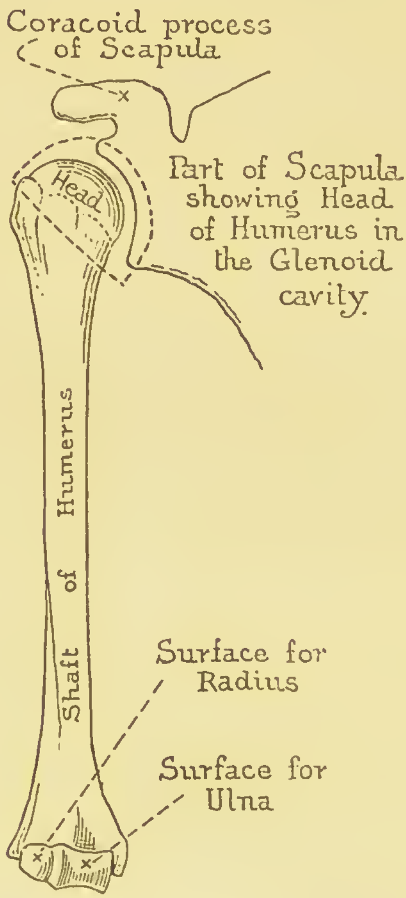

Fig. 5. Front view of Right Humerus, with part of the front of Right Scapula.

acromion to the sternum. In this manner the shoulder is connected to the trunk. The joint between the acromion and clavicle permits a certain amount of movement on the part of the shoulder-blade. The acromion and shoulder end of the clavicle also hang over a hollow of the scapula, called the **glenoid** cavity, which receives the upper end or **head of**

he **humerus**, or bone of the upper arm (figs. 4 and 5). The clavicle is also connected by ligament to another process of bone belonging to the scapula, called the **coracoid process.** In dotted lines (fig. 5) the outline of the **capsular** ligament, which keeps the humerus in its socket, is represented. The shoulder is an example of a ball and socket joint. It permits of very extensive motion. The humerus, like all long bones, consists of a head, shaft, and extremity. The extremity possesses two surfaces for the bones of the fore-arm.

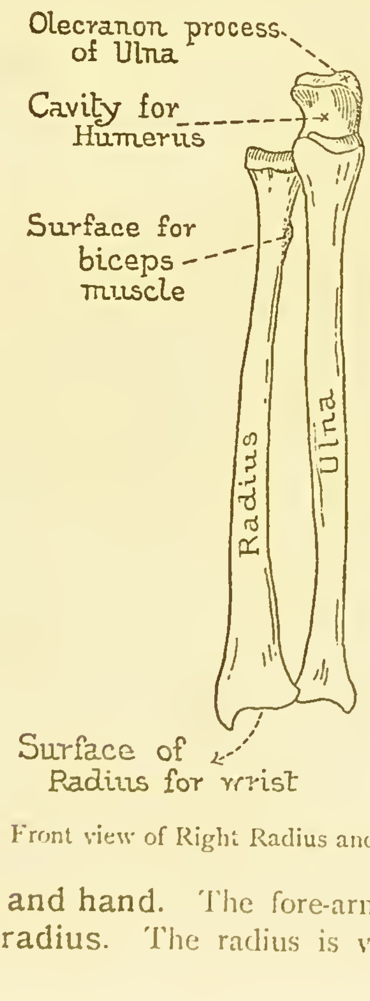

Fig. 6. Front view of Right Radius and Ulna.

28. **Fore-arm and hand.** The fore-arm consists of two bones, **ulna** and **radius.** The radius is very broad below

and articulates with the wrist. The **wrist** or **carpus** (fig. 7) consists of 8 bones arranged in two rows. Attached to the

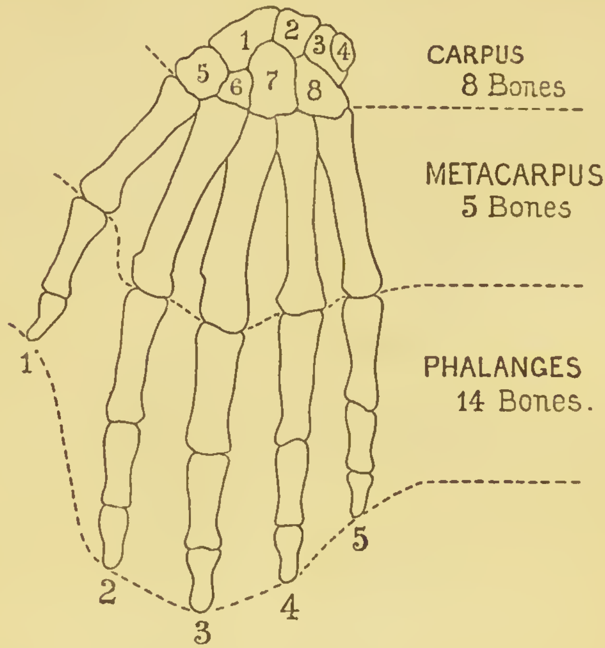

Fig. 7. Back view of the Bones of Left Hand: 1—8, Carpal Bones.

second row are 5 **metacarpal** bones. Each metacarpal bone has attached to it a row of **phalanges**, which form the small bones of the fingers. Each finger has three, the thumb has two. All these bones are attached to each other by strong ligaments. The hand can be moved through a semi-circle. When the hand is placed on the table with the back upwards, as in writing, the position is called **pronation**; when the palm is directed upwards, the position is that of **supination**. These two movements are effected by the **radius**, which rotates round the ulna (and in a small cavity near the elbow, surrounded by a ligament), and carries the hand with it.

29. **The bones of the lower extremity and pelvis.** The thigh bone or femur fits into a socket—**acetabulum**—formed by the **innominate** or hip-bone. The innominate bones are separated from each other behind by the **sacrum**,

with which they articulate; in front, they meet each other and are united by cartilage. The two hip-bones with the sacrum together form a sort of basin called the **pelvis**, which is a

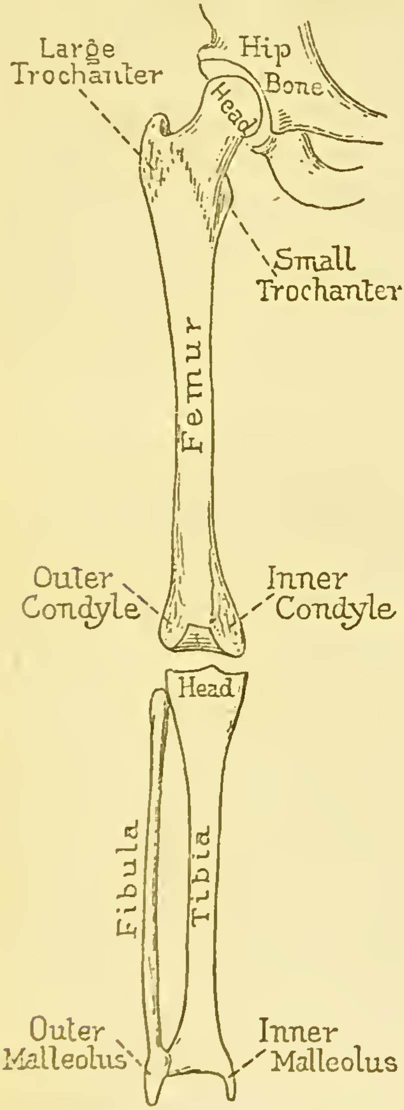

Fig. 8. Right Femur with Tibia and Fibula. Connecting the head of the femur with the socket or acetabulum into which it fits, is a ligament — the round ligament.

hollow cavity. Each hip-bone consists of **ilium, ischium,** and **pubis** (fig. 1), of which the pubis meets its fellow in the

middle line in front. The **femur** is the longest bone in the body, and consists of a **head, neck, two trochanters,** large and small, **of the shaft,** and of the **lower extremity,** consisting of two **condyles,** which articulate with the **tibia** or shin-bone. The bones of the leg proper consist of the **tibia,** articulating with the femur to form the **knee-joint,** and of the **fibula,** which is extremely slender. Below each ends in a process called inner and outer **malleolus,** which hang over the ankle joint (fig. 8). The foot is divided into the **tarsus, metatarsus,** and **phalanges.** The tarsus consists of 7 bones—(1) the **astragalus,** which articulates with the leg-

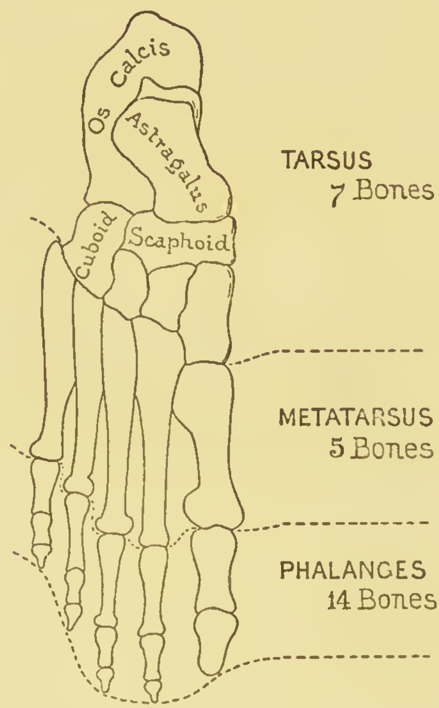

Fig. 9. Upper surface of Right Foot.

bones and forms the ankle joint; (2) the **os calcis,** or bone of the heel; (3) the **scaphoid bone**; (4) the **cuboid bone,** and (5, 6, 7) the **three cuneiform** or wedge-shaped bones. The **metatarsus** consists of 5 bones, each of which, with

the exception of that belonging to the big toe, bears three phalanges. The metatarsal bone of the big toe, like the metacarpal bone of the thumb, only bears two phalanges. A strong ligament (m. fig. 42) passes from the under surface of the os calcis to the scaphoid bone, and supports the astragalus. The weight of the body is conducted by the bones of the pelvis to the thigh-bones, thence to the tibiæ or shin-bones and thence to the astragalus. The **patella or knee-cap** has not yet been mentioned. It lies in front of the knee (fig. 42), and articulates with the tibia and femur.

30. **The viscera.** When a transverse section is made across the body, as across the line AB of fig. 10, a figure like fig. 9A is obtained. We may conceive the body to be made up of

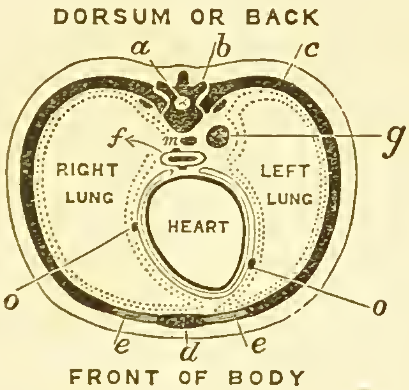

Fig. 9A. Transverse section through the thorax along line A B of Fig. 10: *a*, spinal canal within the vertebra; *b*, transverse process; *c*, rib; *d*, sternum; *e*, cartilage of rib; *f*, œsophagus; *g*, aorta; *m*, thoracic duct; *o*, nerve (phrenic), which passes to the diaphragm. The pleura is indicated by dotted lines.

two cavities, a **smaller** enclosed by the vertebræ and containing the spinal cord, and a larger cavity in front containing the viscera.

31. The **thorax** (fig. 9A and 11) contains the **heart,**

with the larger **blood-vessels**, the **lungs**, and, behind, the **gullet** (*f*, fig. 9A), and the **thoracic duct** (*m*, fig. 9A). The

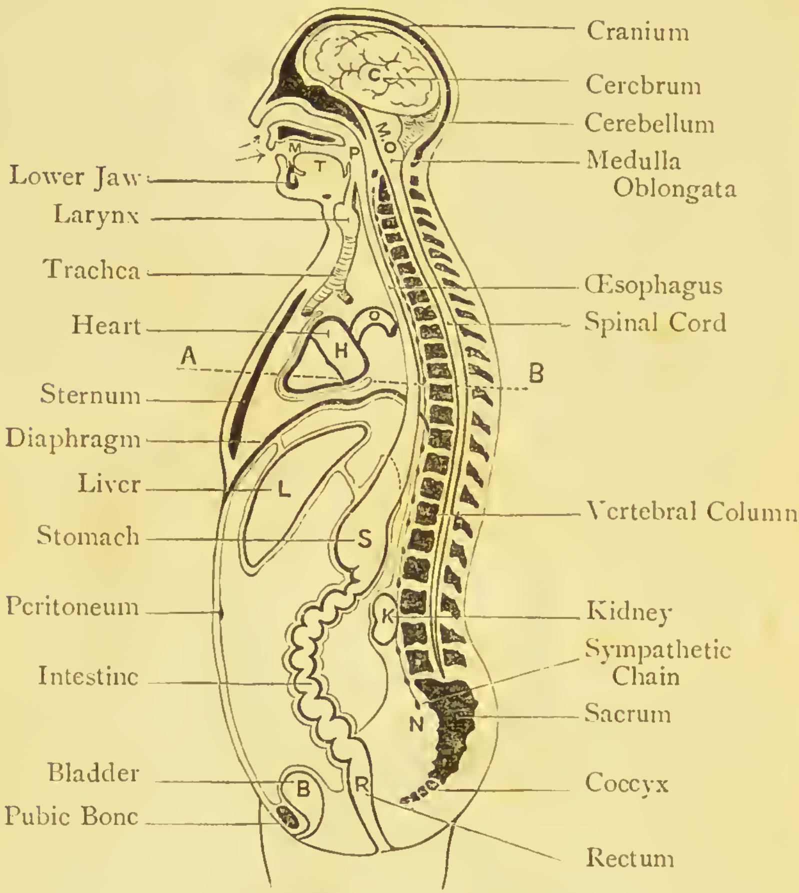

Fig. 10. Section through the middle of Head and Trunk, diagrammatic. C, cerebrum ; M O, medulla oblongata ; M, mouth ; P, pharynx ; S, stomach ; R, rectum ; B, bladder ; H, heart ; T, tongue ; O, aorta ; K, kidney ; N, sympathetic chain of nerves. The Pericardium and Peritoneum are also indicated.

heart contains 4 chambers (see fig. 12), of which the upper are called **auricles** (*RA and LA*, fig. 12), the lower are **ventricles** (*RV* and *LV*, fig. 12). There is thus a right half

consisting of right auricle and right ventricle, and a left half of left auricle and left ventricle. Blood vessels which carry

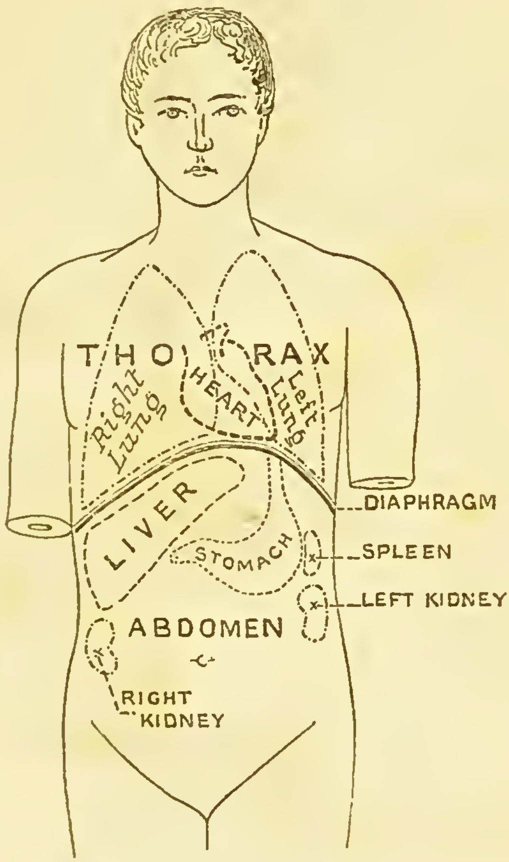

Fig. 11. Diagram to represent situation of the important organs in the Chest and Abdomen. The intestines have been removed to show the position of the kidneys, which lie behind them.

blood from the heart are called **arteries**; those which carry blood into the heart are called **veins**. Thus, the right ventricle sends blood to the lungs by the **pulmonary artery** (fig. 12), the left sends blood to the body through the

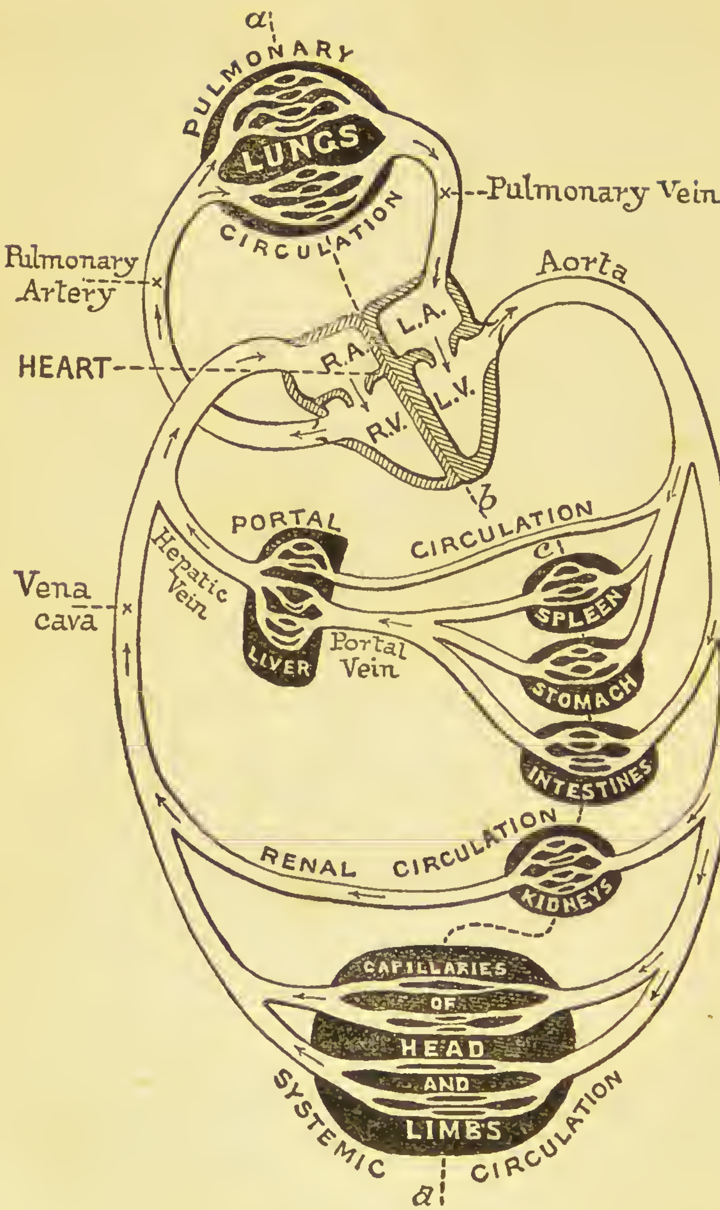

Fig. 12. Diagram of the Circulation. R.A., right auricle; R.V., right ventricle; L.A., left auricle; L.V., left ventricle. All the blood on the Right side of the lines *a b*, *c d* is pure or oxygenated blood; on the Left, impure or venous blood.

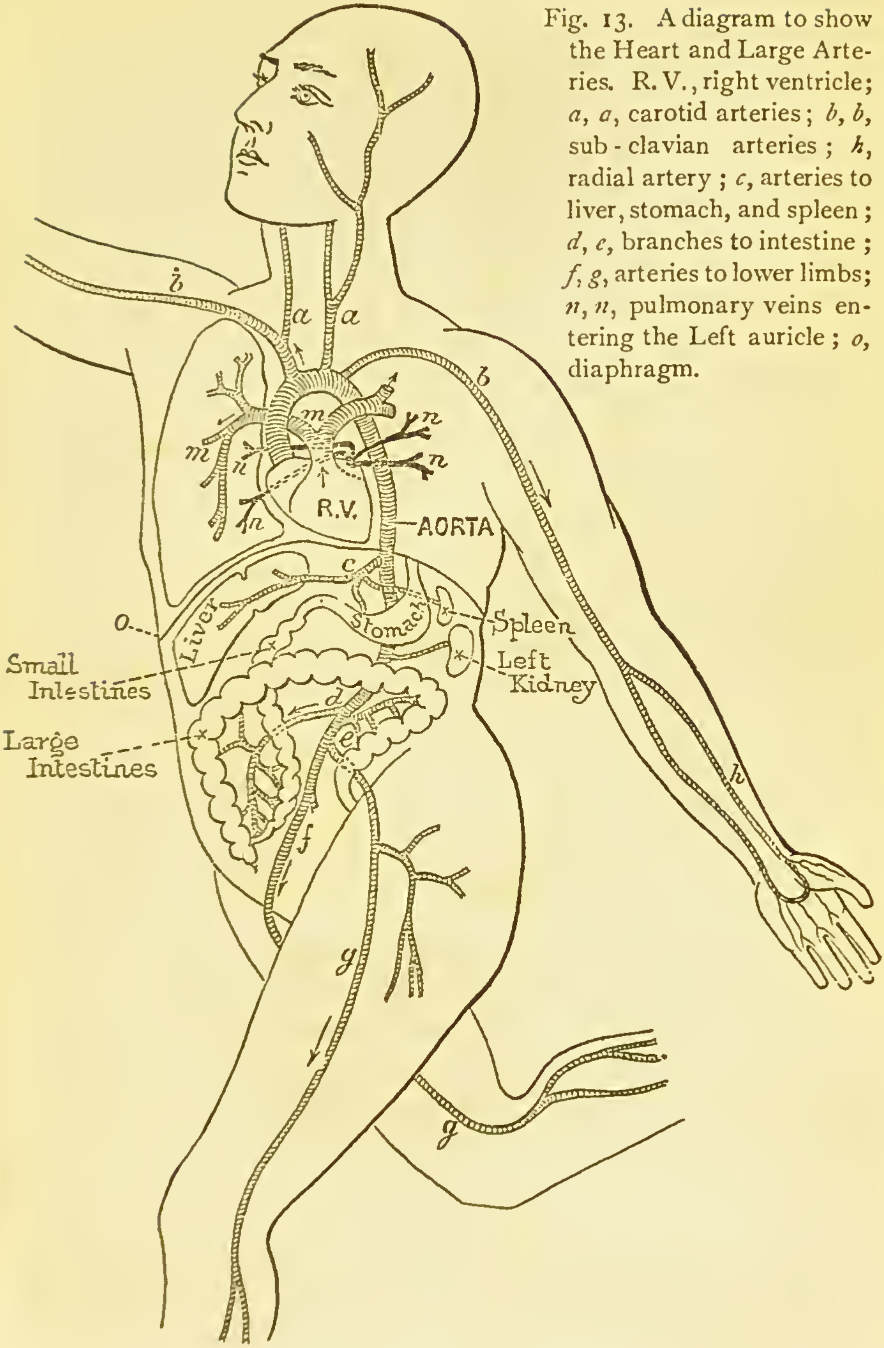

Fig. 13. A diagram to show the Heart and Large Arteries. R. V., right ventricle; *a*, *a*, carotid arteries; *b*, *b*, sub-clavian arteries; *h*, radial artery; *c*, arteries to liver, stomach, and spleen; *d*, *e*, branches to intestine; *f*, *g*, arteries to lower limbs; *n*, *n*, pulmonary veins entering the Left auricle; *o*, diaphragm.

aorta (fig. 13). The aorta sends a branch (*bb*, fig. 13) to each arm, called the **subclavian** artery, and a branch on each side of the neck (*aa*, fig. 13), called the **carotid.** The carotid arteries carry blood to the face and brain. At the elbow the artery of the arm divides, and one of these (*h*, fig. 13) is readily felt at the wrist on the thumb side, where it forms the pulse. This is the **radial** artery. The heart is enclosed in a bag called the **pericardium** (fig. 10), which consists of two layers, between which is fluid. The lungs are two in number, right and left. From each a tube arises called the **bronchus.** These two bronchi unite to form the **trachea** or windpipe, which dilates in the neck somewhat, forming the **larynx** or voice box, and then opens into the back part of the mouth or **pharynx** (P, fig. 10). Each lung is inclosed in a bag called the **pleura,** which consists of two layers (see dotted lines fig. 9A), one of which lines the thorax, and the other is reflected over the lungs. The surfaces which look towards each other are moistened with fluid, and move easily one over the other.

32. The **œsophagus** or gullet (fig. 10) carries the food from the pharynx into the stomach. The **thoracic** duct lies at the back of the chest (*m*, fig. 9A). It is a small tube, important since it carries some of the materials absorbed from the intestines into the blood. The floor of the thorax is formed by a partition called the **diaphragm** (figs. 10 and 11). It thus separates the thorax from the abdomen. In the middle it is tendinous, at the sides muscular and attached to the ribs. The **inferior vena cava** (a large vein bringing the blood from abdomen and legs to the right auricle of the heart) and the œsophagus pass through the diaphragm, while behind and close to the vertebral column a space is left, through which the aorta and thoracic duct pass into the abdomen.

33. The **abdomen** contains the stomach with the small and large intestines, the liver, pancreas, spleen, kidneys and

bladder. The **stomach** lies on the left side (fig. 11) just beneath the diaphragm and heart, and is to some extent covered by the **liver.** At one end, the **cardiac,** it receives the œsophagus, while the opposite end, called **pylorus,** enters the small intestine. The **small intestines,** about 20 feet long, are divided into **duodenum, jejunum,** and **ileum.** The ileum enters the large intestine, which is about 6 feet long, and divided into **cœcum,** with **vermiform appendix, colon,** and **rectum** (fig. 36).

34. The **spleen** is a dark red organ connected to the left side of the stomach by a fold of membrane which forms part of the **peritoneum.** This membrane (fig. 10) lines the cavity of the abdomen and is reflected over the organs within it. Thus the liver and stomach are completely enclosed. That portion of the peritoneum which is reflected over the small intestines is termed the **mesentery.** Behind, the mesentery is fixed to the vertebral column. The **liver** lies just beneath the diaphragm. In the adult it weighs 3 lbs. When the liver is slightly tilted upwards the **gall-bladder**—a greenish bag—becomes visible. It is the receptacle for bile. The **pancreas** is an elongated organ situated behind the stomach (see fig. 36). It possesses a duct or canal, which opens with the duct from the gall-bladder—called bile-duct—into the duodenum. One end of the pancreas touches the spleen.

35. The **kidneys,** two in number, are situated at the back of the abdomen, and are not visible before the intestines have been removed (fig. 11). Each weighs about 4 ounces. From each a tube, called the **ureter,** passes, which carries off the urine and enters the **bladder.** The latter organ lies in the lower part of the abdominal cavity (fig. 10B).

36. The **aorta** enters the abdomen behind (fig. 13); it at once gives a branch to the liver, stomach and spleen. Then it gives off arteries (*d*, *e*, fig. 13) to the intestines, called **mesenteric**; a branch to each kidney, called the **renal**

artery, and then divides into two branches, which enter the lower limbs (*gg*, fig. 13).

37. **The mouth and pharynx.** Above, the œsophagus enters the pharynx (*P*, fig. 10), which lies at the back part of the throat, and into which the mouth enters. From the same drawing it is seen that the nostril leads into the nose and opens behind into the pharynx; these two openings of the nostrils are called the **posterior nares.** They represent the orifices of canals along which air passes when the mouth is kept shut. The pharynx opens below into the œsophagus, and into the larynx. Besides these openings into the pharynx there are two—one on each side—called the **eustachian tubes.** These open close to the posterior nares, and lead to the external auditory meatus, or passage of the external ear. But this channel is separated into two by the tympanum or drum of the ear.

38. The **cavity of the cranium and vertebral column** (fig. 10) is occupied by the brain and spinal cord. The cavity in the backbone ends near the sacrum, but the spinal cord itself ceases about the level of the second lumbar vertebra. Above the spinal cord passes through the foramen magnum, and joins the **medulla oblongata** (*MO*, fig 10). The main mass of the brain, however, is formed by the cerebral hemispheres or **cerebrum** (*C*, fig. 10) and the **cerebellum.** The brain and cord are covered externally by three membranes; the outermost is termed **dura mater.** In the cord this is loose and does not line the canal, but in the skull it lines the interior very closely, and forms a periosteum for it. The **spinal nerves**—31 pairs—pass out between the vertebræ, and consist at first of two roots, one lying to the front called the **anterior root,** and one behind—**posterior root.** These unite just as they are passing through the openings between the vertebræ. They will be described hereafter.

There is a special set of nerves to supply the alimentary canal, the heart and blood-vessels, which is called the **sym-**

pathetic system. It consists of two long cords, which run down on either side of the backbone, in the neck, chest, and abdomen, and at regular intervals the cords show thickenings called ganglia (N, fig. 10).

CHAPTER IV.

THE HISTOLOGY OF THE BODY OR MINUTE STRUCTURE OF THE TISSUES.

39. At an early period of its history the body is composed entirely of small rounded particles only visible by means of the higher powers of the microscope. These small particles have been termed **cells.** A typical cell consists of a soft material called **protoplasm.** Each cell (fig. 14) contains in its interior

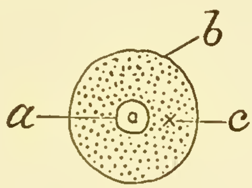

Fig. 14. A Typical Cell highly magnified : *a*, nucleus ; *b*, cell-wall ; *c*, protoplasm.

a somewhat denser and rounded portion called the **nucleus,** of which there may be, however, more than one. By the action of staining fluids like logwood the nucleus often assumes a darker tint and thereby becomes more conspicuous. The protoplasm of the cell also contains granules of different size, some of which are minute globules of oil, others are granules of glycogen. The protoplasm of the exterior often becomes denser than that of the interior and is then termed a **cell-wall.**

40. Most cells in an early stage of existence possess the power of changing their shape—a property conferred upon them by virtue of the protoplasm of which they are composed. Thus the white blood-corpuscles of man, if kept moist and warm, may be seen under the microscope to change their form —**amœboid movement**—and place. Further, their protoplasm will take up and pass into its interior small granules with which it may come into contact. In this way the cell may be actually **fed** with carmine grains, or with granules of blue litmus. The cell may also extrude them subsequently. Protoplasm is of essential importance to the economy, since it possesses all the attributes of life in miniature. Some of the lowest types of animal life consist merely of such a cell as represented in fig. 14. But this speck of protoplasm takes in food particles, digests them, and uses up the oxygen dissolved in water; in other words, it respires and gives off carbonic acid. Finally, each cell divides into two, and each half enjoys an independent existence.

41. The cells being all similar in shape at a certain stage, afterwards become modified in accordance with the functions they are destined to perform. Some become cylindrical, others flattened, some join end to end to become muscle or nerve fibres, others throw out long processes, which unite with each other, forming a network. On the surface of the skin **(epidermis)** and lining the viscera of the thorax and abdomen the cells become arranged in layers called layers of **epithelium.** Thus on the surface of the tongue there are several layers of cells (fig. 15) forming a **stratified epithelium.** The lowest

Fig. 15. Stratified Epithelium from cat's tongue, highly magnified: *a*, deepest layer of columnar cells; *b*, most superficial of squamous cells.

are columnar or somewhat cylindrical in shape, and as we pass towards the surface they change in form, becoming somewhat flatter. The most superficial layers, in fact, are quite flat in shape, like the scales of a fish, and are called **squamous** cells. Such squamous cells are easily obtained from the inside of the mouth (fig. 16).

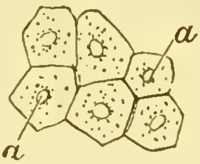

Fig. 16. Squamous Cells from the inside of mouth, magnified 60 diameters: *a*, nucleus. Six cells are indicated.

42. On the mucous membrane of the stomach and intestines, including the **villi** (which are small finger-like projections of the mucous membrane), the cells are columnar, arranged side by side and in one layer. This constitutes **columnar epithelium** (fig. 17). In some parts of the body, as in the trachea and

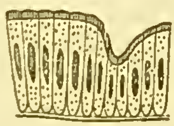

Fig. 17. Columnar Epithelium from the villus of a cat. Twelve columnar cells are represented; magnified 350 diameters.

bronchi, the superficial layer of cells consists of columnar cells, the free ends of which are provided with very fine processes, like hairs, which during life are constantly in motion, and are termed **cilia** (fig. 18). Such cells may also be easily obtained

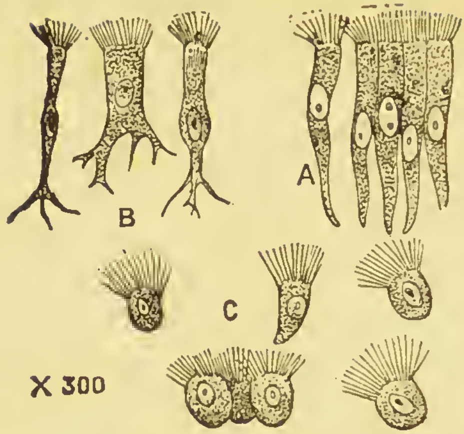

Fig. 18. Ciliated cells: A, B, from the trachea; C, from mouth of frog. Magnified 300 diameters.

from the roof of the mouth, and tongue of a frog, also from the gills of many shell-fish, as the mussel. Another form of cell, termed **cubical** or **spheroidal,** from its shape, is met with in the glands of the body, as the salivary glands, or the glands of Brunner, which occur in the duodenum only (fig. 19). A

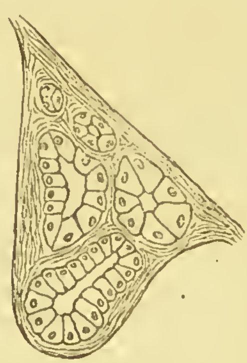

Fig. 19. A small portion of one of Brunner's Glands of the duodenum of the cat. Highly magnified to show cubical cells of glands.

variety of epithelium, called **endothelium,** covers the pleura, the pericardium, and peritoneum, also the interior of the

blood-vessels and heart. This consists of very flat cells united closely together, and generally possessing wavy edges (fig. 20).

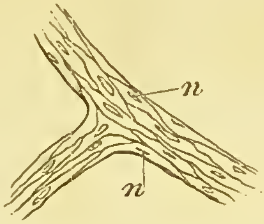

Fig. 20. A diagram of the Endothelium lining a minute artery: *n*, *n*, nucleus.

43. **Connective tissue** derives its name from the fact that it binds together the various tissues throughout the body. It unites the fibres of muscle and nerve together. It occurs abundantly in the walls of blood-vessels, beneath the skin and mucous membrane. When stained with logwood its different parts are more readily discernible. It consists (1) of the **connective-tissue corpuscles** (*c*, fig. 21), which are long, possess

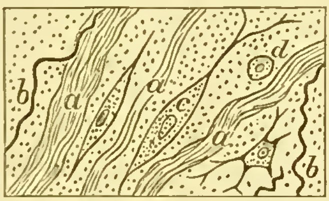

Fig. 21. Connective Tissue, highly magnified: *a*, white fibres; *b*, elastic fibres; *c*, connective tissue corpuscles: *d*, wandering cell.

fine branched processes and a nucleus, and they lie in **spaces**; (2) **fine filaments** (*a*), which are united and form bundles, called **white fibrous tissue**; (3) other fibres are seen which are curled up at the edges, termed **elastic** fibres (*b*); (4) small round nucleated and granular cells may also be apparent (*d*), which have passed through the walls of the blood capillaries and come to lie in the spaces already mentioned. These are

called **wandering cells.** When treated with weak acetic acid (white vinegar) the white fibres swell up and disappear, while the cells and elastic fibres remain. The ligaments between the arches of the vertebræ are entirely elastic tissue, that is, composed of elastic fibres, and so is an important ligament in the neck of quadrupeds, called the **ligamentum nuchæ.** Elastic tissue also occurs plentifully in the walls of arteries, in the vocal cords, and beneath the skin. White fibrous tissue is met with in the ordinary ligaments of the body, and in the tough membrane which covers bone, called periosteum.

44. **Tendons,** commonly called sinews, which unite muscles to bone, are also composed of bundles of white fibrous tissue, but between the bundles are rows of spaces containing cells (fig. 22). **Adipose tissue** or fat is a variety of con-

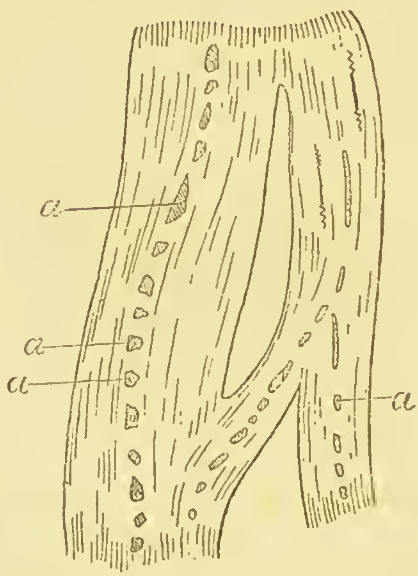

Fig. 22. A small portion of Tendon, to show the Tendon Cells, *a*, *a*, *a*, in columns. Highly magnified.

nective tissue (fig. 23) in which the connective tissue corpuscles have drawn in their processes again, and the protoplasm of the

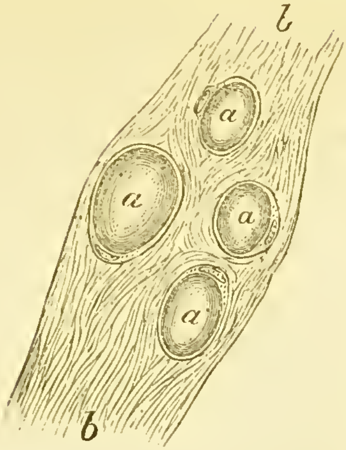

Fig. 23. Adipose Tissue : *a*, *a*, fat cells, showing a nucleus at one part of the cell ; *b*, *b*, white fibrous tissue. Highly magnified.

cell has secreted fat into its interior. Only a small rim of granular protoplasm, containing a nucleus, remains behind.

45. **Cartilage** (fig. 24). The ends of the long bones are

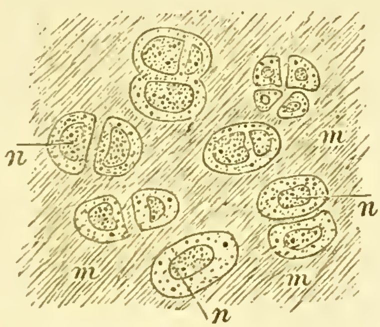

Fig. 24. Cartilage Cells, magnified 300 diameters : *n*, *n*, nuclei ; *m*, *m*, matrix of the cartilage.

covered with a bluish layer which consists of cartilage. In the trachea and bronchi, in the ends of the ribs where they join the sternum, cartilage is also abundant. It consists of cells which are nucleated. The substance between the cells, called the **matrix**, may possess no apparent structure ; or it may contain

many white fibres, as in the intervertebral discs; or it may contain elastic fibres, as in the **epiglottis.** Cartilage contains no blood-vessels.

46. **Bone or osseous tissue** (figs. 25, 26, 27). The

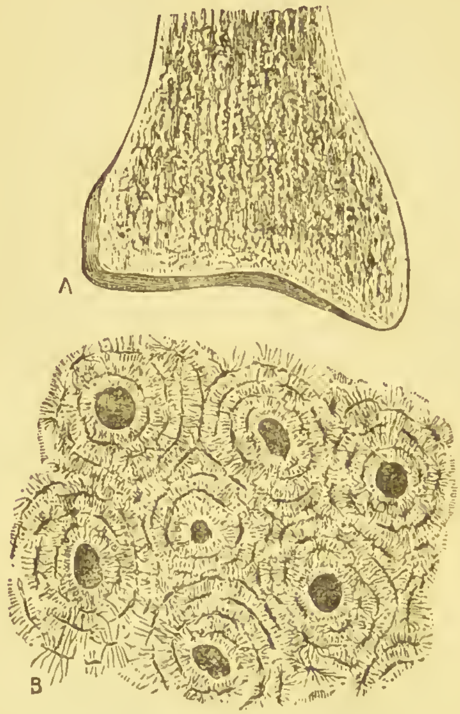

Fig. 25. Transverse Section of Bone, B, magnified about 80 diameters. The dark spots are the Haversian canals; A, section of the end of a bone, showing the porous nature of the interior (natural size).

bones are usually divided into (1) **long** bones, which are hollow like the femur and humerus, (2) **short** bones, which are irregular in shape, and (3) the **flat** bones. The long bones consist of a shaft with two extremities. They are covered externally by the **periosteum.** The hardness is due to the presence of phosphate and carbonate of lime. In the interior the long bones contain a cavity called the **medullary cavity,** which in the fresh state is filled with **marrow.** If a thin slice

of the shaft of the femur be prepared and examined with the microscope, a number of holes, which appear dark, become visible (fig. 25). These holes are sections of canals — **Haversian canals**—which traverse the bone, and contain blood-vessels and lymphatics. Around each canal a number of layers, arranged concentrically, may be observed, and between these layers many irregular spaces, also dark, are

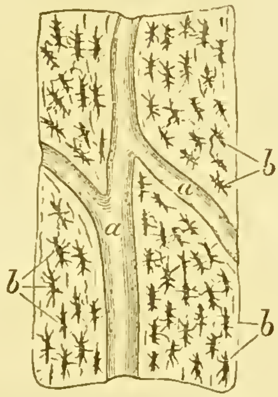

Fig. 26. Longitudinal Section of Bone, magnified: *a*, *a*, Haversian canals; *b*, *b*, lacunæ with canaliculi.

apparent. These spaces are termed **lacunæ** (*b*, fig. 26). Running out from the lacunæ are very fine lines, really minute canals, called **canaliculi**, which communicate with

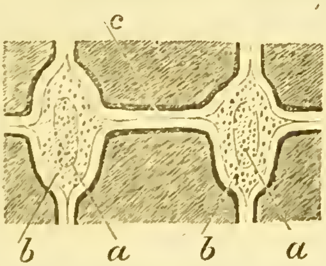

Fig. 27. Diagram of two Lacunæ which communicate by the canaliculus, *c*. Lacunæ are occupied by bone cells, *b*, *b*, with processes; *a*, nucleus. Very highly magnified.

those belonging to other lacunæ. In the fresh and living state each lacuna contains a corpuscle or **bone-cell,** the processes of which pass into the canaliculi and communicate with the processes of other cells (fig. 27). These remind us of the corpuscles of connective tissue.

47. In the heads of the long bones the osseous tissue is **spongy** and porous. It is hence called **spongy** bone. The **flat** bones (see fig. 3) consist of an inner and outer layer of dense bone, while the interval is filled with spongy bone. The **marrow,** found in the interior of the long bones, consists of fat cells, and of cells peculiar to marrow, called marrow cells. Some of these are very small, round, nucleated, and reddish. Other cells occur, termed giant-cells. These may possess many nuclei. The spaces of spongy bone also contain a small quantity of marrow, which has a reddish tinge.

48. Muscle is of two kinds, **unstriped** and **striped.** Un-

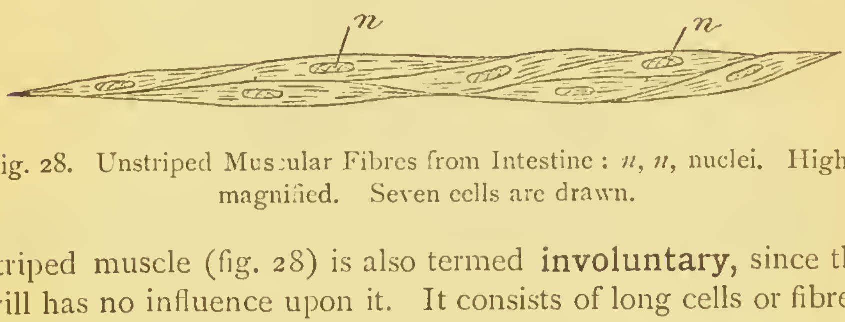

Fig. 28. Unstriped Muscular Fibres from Intestine: *n*, *n*, nuclei. Highly magnified. Seven cells are drawn.

striped muscle (fig. 28) is also termed **involuntary,** since the will has no influence upon it. It consists of long cells or fibres, each of which is nucleated. It is found in the middle coat of arteries and veins, in the walls of the alimentary canal and bladder, in the walls of the air tubes, in the iris of the eye, and in the skin attached to the roots of the hairs. **Striped muscle,** so called from the transverse markings or **striæ** which the microscope reveals, is also called **voluntary,** since it forms the muscles of the limbs, &c., which we can put into action when we please. We can easily split up a piece of cooked muscle into lesser bundles with the fingers, and by using fine needles and the microscope each of these bundles

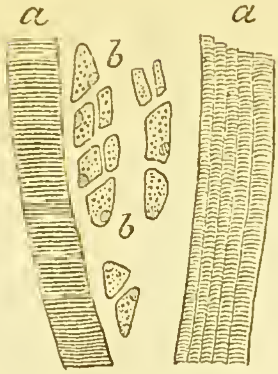

Fig. 29. Striped Muscular Fibre from cat's tongue : *a*, *a*, longitudinal, *b*, *b*, transverse section of fibres. Highly magnified.

may be further split up until we arrive ultimately at single **fibres.** Each fibre possesses a sheath of connective tissue with nuclei, called its **sarcolemma.** When the muscles of the rabbit are examined perfectly fresh with the highest magnifying powers of the microscope, each fibre is seen to be made up of a number of transverse bands, alternately dim and bright, and in the middle of the bright stripe is a transverse layer of granules (fig. 29A). The fibres possess nuclei of their own

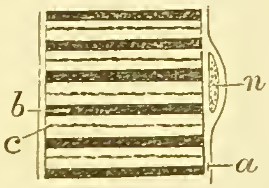

Fig. 29A. Diagram of a Muscular Fibre : *b*, dim stripe ; *c*, bright stripe with layer of granules ; *a*, sarcolemma, with nucleus, *n*.

—they are situated just beneath the sarcolemma. Each muscular fibre is also provided with a minute nerve fibre which pierces the sarcolemma and ends in the muscular substance. The **fibres of the heart** (fig. 30) are short and branched. They possess no sarcolemma, and their nuclei are

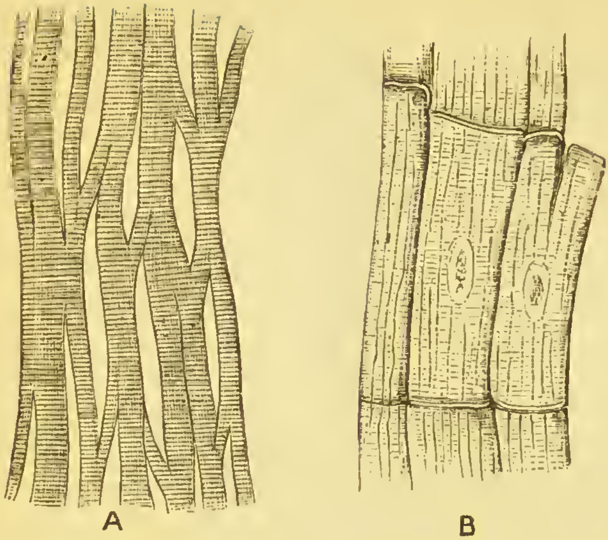

Fig. 30. Muscular Fibres from the Heart, magnified: A shows the branching of the fibres; B, the nuclei in the fibres.

in the middle of the thickness of the fibre. They possess longitudinal as well as transverse stripes.

49. **Nervous tissue** consists of **nerve fibres** and **nerve or ganglion cells.** The nerves are white cords, easily seen between the muscles of the back of the thigh of a recently killed rabbit. Each nerve contains a number of nerve-fibres

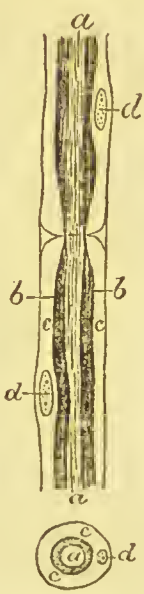

Fig. 31. A Nerve Fibre, highly magnified; *a*, *a*, axis cylinder; *c*, *c*, nucleated sheath with *d*, nucleus. The dark layer represents the medullary sheath, *b*. Below, a section of the fibre, with the same letters, is represented.

arranged in groups. Each nerve fibre possesses a fine central thread called the **axis-cylinder** (fig. 31*a*) which is surrounded by two layers. The innermost is called the **medullary sheath,** since it is of a fatty nature and rendered black by osmic acid, as in figure 31. Outside is the **nucleated sheath,** which exhibits nuclei at intervals. In many of the fibres of the sympathetic system, the inner or medullary sheath is absent. Such nerves from their color are termed **gray fibres.**

50. When a nerve fibre is followed to the brain it is found to end in a **nerve cell.** These nerve cells are collected into

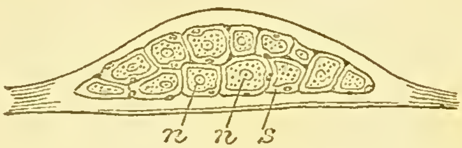

Fig. 32. A small portion of the Ganglion on the Posterior Root of a Spinal Nerve: *n*, *n*, nuclei of the nerve cells; *s*, sheath of cell. Magnified.

groups in some parts of the body, and such collections are termed **ganglia.** A small portion of one of the ganglia found on the spinal nerves is represented in fig. 32. These cells are nucleated, and are enclosed in a sheath (fig. 33). They also possess processes which are continuous with the axis cylinder

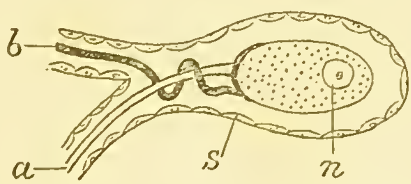

Fig. 33. Diagram of a Ganglion Cell: *a*, straight fibre; *b*, spiral fibre; *n*, nucleus; *s*, sheath.

of nerves. Of these processes one may be twisted in a spiral fashion. At their terminations the nerves may form a **net-**

work or **plexus** such as is seen between the muscles of the intestine (fig. 34).

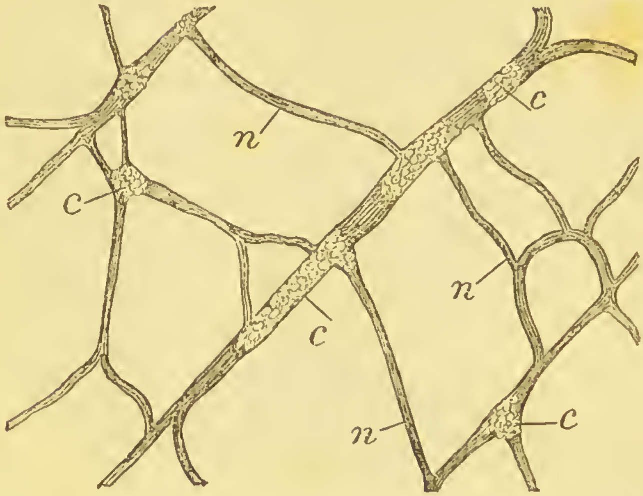

Fig. 34. A Nerve Plexus in the Muscular Wall of the Intestine: *n*, nerve fibres; *c*, *c*, nerve cells.

51. In the course of the lymphatic vessels there are enlargements called **lymphatic glands.** These consist of a very fine kind of connective tissue, the networks of which are formed by the union of the processes of the cells. These

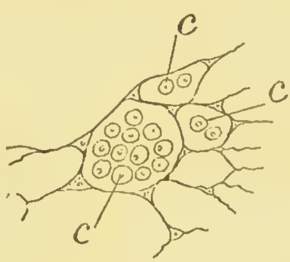

Fig. 35. Diagram of Lymph Cells, *c*, *c*, *c*, lying in a Network of Lymphoid Tissue. Very highly magnified.

meshes contain small rounded cells (*c*, fig. 35) called **lymph cells**. Such tissue is termed **lymphoid** or **adenoid.** It also occurs abundantly in the whole length of the mucous membrane of the alimentary canal.

CHAPTER V.

THE FUNCTIONS OF THE BODY.

52. As a consequence of its activity the body loses daily about 5 lbs. of water, about 2 lbs. of carbonic acid, and one ounce of urea, which latter is the form under which nitrogen leaves the body. This amount of urea contains the same quantity of nitrogen as $\frac{3}{4}$ lbs. of uncooked flesh. The carbonic acid and water are given off by the lungs.

On blowing into lime water, through a tube, a turbidity is produced—a proof that the breath contains carbonic acid. Moreover everyone must have noticed the drops of water trickling down the walls of a hall containing a crowded audience; the moisture, during cold weather, on the windows of railway carriages; and the dimness produced on a looking glass when the breath is directed upon it. All these are proofs that the lungs excrete water. The skin gives off water in the form of perspiration, while the kidneys excrete water and urea.

53. This daily loss must be repaired, and new matter in the shape of food and water must be added as compensation. The object of digestion is attained by reducing the food to a state of solution so that it may be absorbed and taken up by the blood. The digestive system consists of a long tube which commences at the mouth. From the mouth the food passes into a cavity at the back of the throat, called the **pharynx**, and is thence carried by the gullet into the stomach. The small intestines form a convoluted tube about 20 feet long, leading from the stomach to the last portion of the alimentary canal, which is more capacious and termed the large intestine. This is about 6 feet long. The whole of the

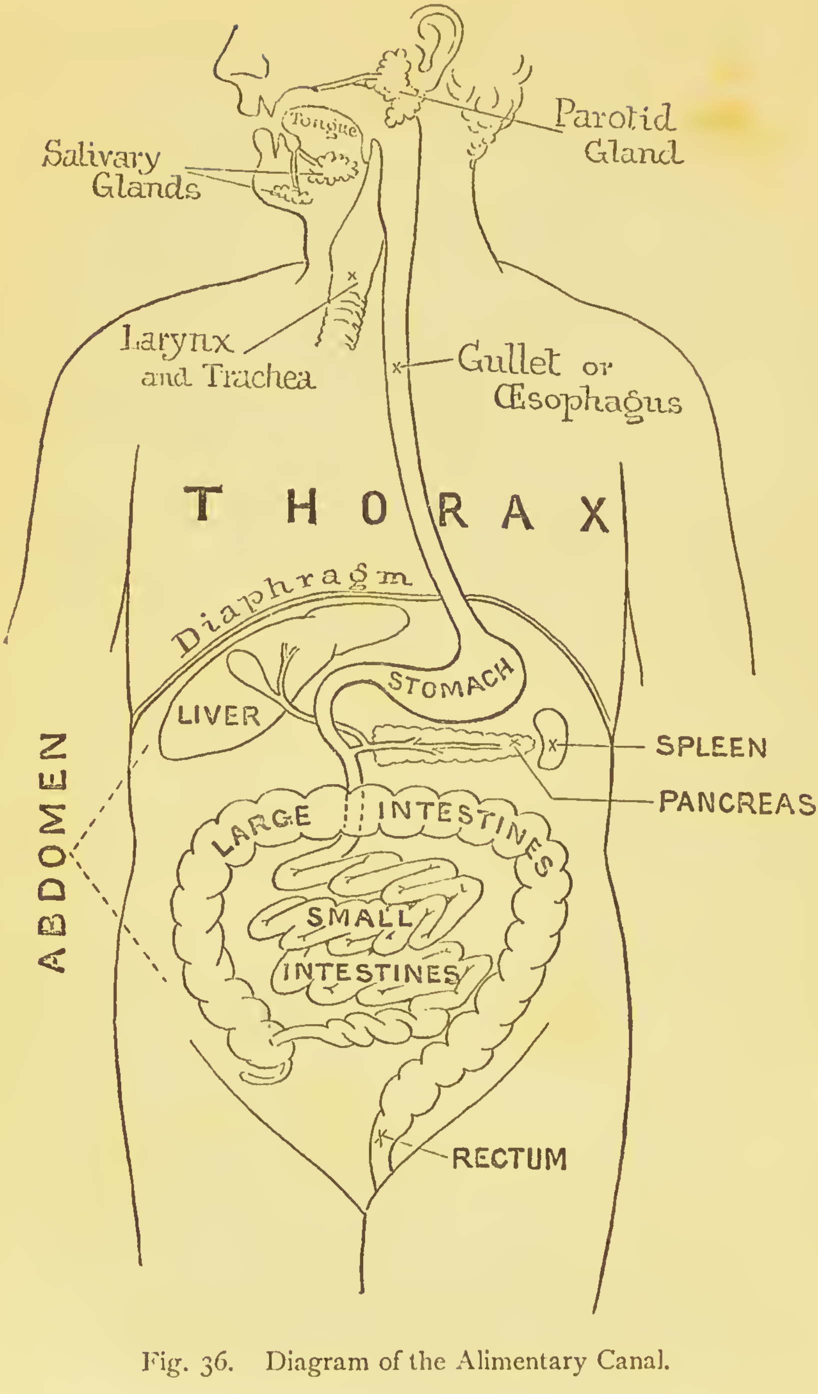

Fig. 36. Diagram of the Alimentary Canal.

canal is lined by a delicate so-called mucous membrane, continuous at the lips with the skin, and on the outside the tube is strengthened by muscular tissue of the involuntary kind. Into the cavity of the mouth open the ducts of the salivary glands; the gastric glands lie in the wall of the stomach and pour their secretion into its cavity, while into the duodenum, or first part of the small intestine, the ducts of the pancreas and liver open and empty themselves.

54. By the process of **absorption,** the digested food, reduced to a suitable state of solution, is carried into the blood. A certain portion passes directly into the capillaries, which are spread out in the form of a close network over the stomach and intestines, and thence it is carried by the veins at

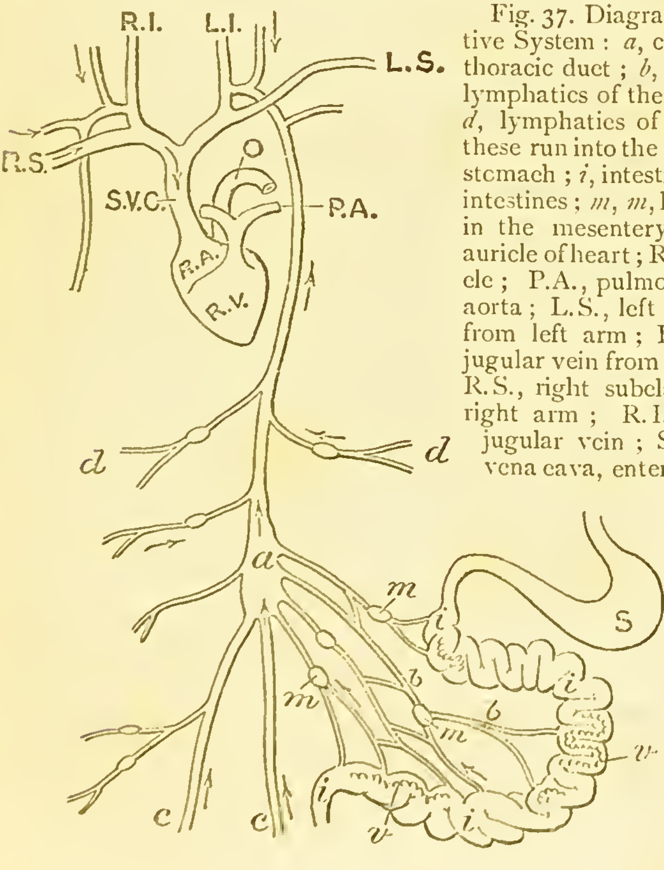

Fig. 37. Diagram of the Absorptive System: *a*, commencement of thoracic duct; *b*, *b*, lacteals; *c*, *c*, lymphatics of the lower limbs; *d*, *d*, lymphatics of the chest. All these run into the thoracic duct. *s*, stomach; *i*, intestines; *v*, *v*, villi of intestines; *m*, *m*, lymphatic glands in the mesentery; R.A., right auricle of heart; R.V., right ventricle; P.A., pulmonary artery; O, aorta; L.S., left subclavian vein from left arm; L.I., left internal jugular vein from neck and brain; R.S., right subclavian vein from right arm; R.I., right internal jugular vein; S.V.C., superior vena cava, entering right auricle. The thoracic duct opens at the junction of left internal jugular and left subclavian veins. The arrows indicate direction of flow of the lymph, chyle and blood.

once to the liver. The second and remaining portion passes through fine processes of the small intestine called **villi**, and thence enters the lacteals of the mesentery. The **lacteals** carry it into the thoracic duct which enters the veins at the lower part of the neck. The second portion thus reaches the circulation, but indirectly.

55. The circulation of the blood is effected by the heart and its vessels. The heart is a hollow, muscular pump, completely

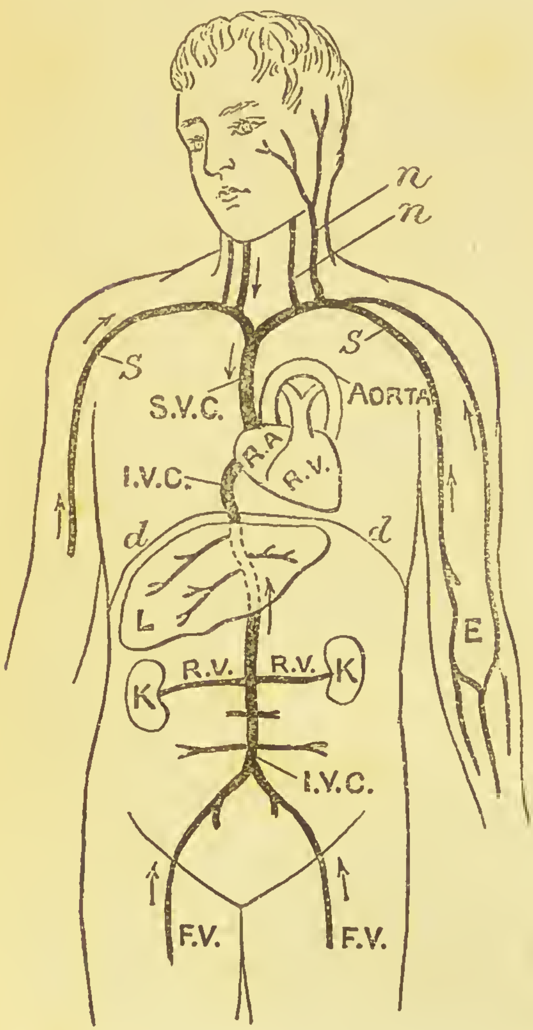

Fig. 38. A Diagram of the Principal Systemic Veins: I.V.C., inferior vena cava, formed by the union of the two veins from the lower limbs; R.V., renal veins, also entering inferior vena cava; K, kidney; L, liver, showing three hepatic veins entering the inferior vena cava; R.A., right auricle, into which inferior vena cava pours its blood; S.V.C., superior vena cava, also entering right auricle; *S*, subclavian veins; *n*, *n*, veins of neck (jugular veins); *d*, diaphragm; E, veins of arm. The intestines and stomach have been removed. The arrows indicate direction in which the blood flows.

separable into two halves. The right half drives the blood through the lungs; the left and much stronger half through the trunk, head, and limbs. Over the body the blood is distributed by the vessels—**arteries**—which become gradually smaller and smaller, as they give off branches, until finally they end in a very fine system of vessels, each of which is composed of only one thin single layer of cells, called the **capillaries**. Through this layer the blood transudes into the surrounding tissues and brings nourishment to them. The remainder of the blood passes on into vessels, which gradually become larger by union with each other, called **veins**. These finally terminate in the right half of the heart. The right half drives this blood, which has become charged with **carbonic acid** and has lost much of its **oxygen**, into the tissues of the body, to the lungs, where it is spread out into a very fine and delicate network, and thus exposed to the oxygen of the inspired air. Here the blood loses carbonic acid and water and receives oxygen. From the lungs the blood is carried to the left half of the heart and is then distributed over the body again.

56. The blood supplying the alimentary canal, as it lies in the abdomen, is finally collected into a large vessel called the **Portal vein**, which branches out in the substance of the liver, just like an artery, and ends in capillaries. These capillaries re-unite into larger vessels called **Hepatic veins**, which enter the **Inferior vena cava**. The blood is thus carried to the right half of the heart. This is termed the **Portal circulation**. (See fig. 39 and fig. 12.)

57. When the blood transudes through the capillaries, it bathes and feeds the living tissues. The overflow is carried back towards the heart by a special set of vessels, termed the **lymphatic system**. These commence in small spaces existing in all parts where blood capillaries are found (that is everywhere, except in epidermis, epithelium, the nails and the hair, and in cartilage). In these spaces the connective tissue

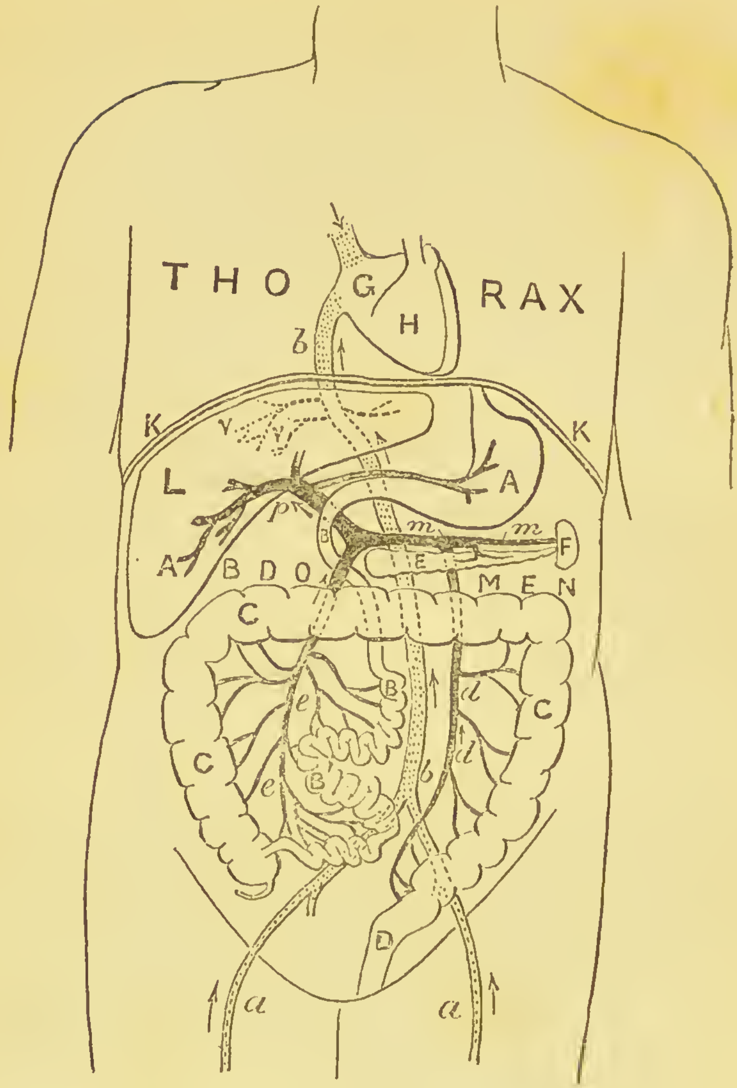

Fig. 39. A Diagram of the Portal Circulation: A, stomach; B, small intestines; C, large intestine; D, rectum; E, Pancreas; F, spleen; G, Right auricle; H, right ventricle; K, K, diaphragm; L, liver; *a*, *a*, veins from lower limbs joining to form the inferior vena cava, *b*, *b*; *p*, the portal vein, formed by the union of *d*, *d*, *d* and *e*, *e*, *e*, the mesenteric veins, with *m*, *m*, the splenic vein. A small vein from stomach also enters the portal vein: *v*, *v*, hepatic veins. The organs have been pulled apart somewhat for the sake of clearness.

corpuscles mentioned in the previous chapter are contained. Besides these, other cells are often found within the spaces. These are called **wandering cells.** They have passed

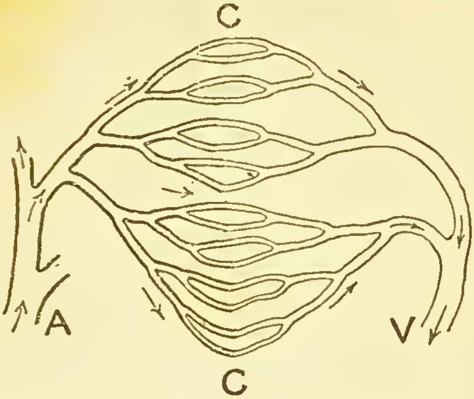

Fig. 40. A small Artery, A, ending in Capillaries, C, which again unite to form the Vein V.

through the walls of the capillaries, and in reality are white blood corpuscles. The spaces end in small vessels called

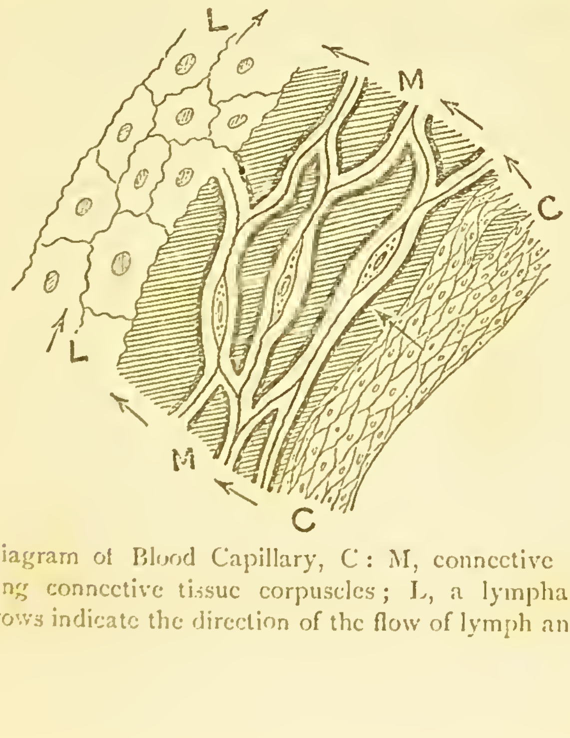

Fig. 41. Diagram of Blood Capillary, C: M, connective tissue spaces containing connective tissue corpuscles; L, a lymphatic capillary. The arrows indicate the direction of the flow of lymph and blood.

lymph capillaries (*L*, fig. 41), which are somewhat larger than blood capillaries, but like them consisting of but one layer. The lymph capillaries unite with each other to form larger vessels. A great many of these, including those of the lower limbs and those of the intestine (which lie in the mesentery and have been already referred to as lacteals), enter the **thoracic duct**, and pass to the veins of the left side of the neck, thus entering the blood. The lymphatics of the right side of the head and right arm enter a vessel which ends in the veins on the right side of the neck.

58. It has been already stated that the blood in passing through the tissues becomes poorer in oxygen. In other words, the tissues possess a greater affinity for oxygen than does the blood itself. Such bodies which give up their oxygen readily are said to be oxidisers, while bodies which have a powerful attraction for oxygen, and take it from others, are called **reducing agents**. The tissues are, therefore, reducing agents. There is a chemical substance termed **alizarin blue**, which parts with its oxygen with difficulty. When the oxygen has been removed, the body becomes white. After this substance has been introduced into the veins of an animal, the tissues of the body after death are blue, with the exception of the interior of the liver and some parts of the kidney, thus showing that the tissues of the liver and kidney are the most powerful reducing agents in the body. On the other hand, all the tissues will reduce some coloured substances which hold their oxygen less firmly.

59. The **muscles** constitute nearly one half of the entire weight of the body. There are two kinds, as already mentioned in the previous chapter. One is dedicated to the use of the internal organs—as the stomach, intestines, and blood-vessels, and termed **involuntary**. The other kind is what we ordinarily speak of as flesh. These are the **voluntary** muscles, and connect various parts of the skeleton with each other. When these muscles are followed out, above and

below, they are found, as a general rule, to be attached to the bone at both ends. At a certain distance from the bone the muscular fibres cease, and the connection is rendered complete by means of **tendons**. Thus the muscle of the calf—the gastrocnemius—is attached above to the lower part of the femur (fig. 42), and below by a strong tendon, called indeed from its strength the **Achilles-tendon**, to the bone of the

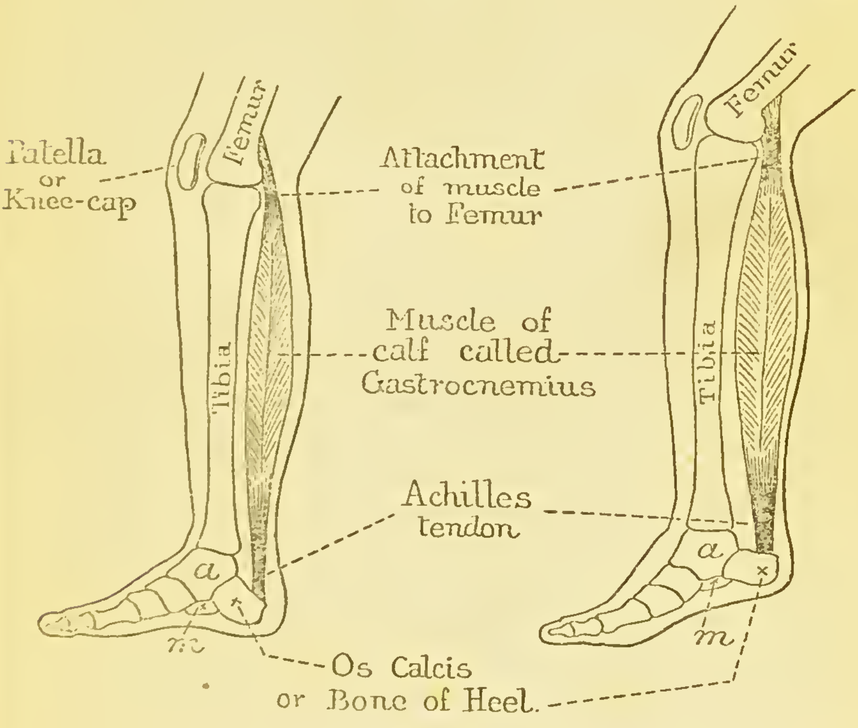

Fig. 42. Diagram of Leg, showing the action of the gastrocnemius muscle: *a*, astragalus; *m*, ligament from os calcis to scaphoid bone.

heel or os calcis. When a muscle contracts, one end which is called its origin remains fixed, while the other, called its insertion, moves. This is accomplished in virtue of the fact, that when a muscle contracts it becomes thicker and shorter, so that whatever is attached to the insertion must approach the

origin, or the muscle or tendon would snap. Thus in fig. 42, the ankle joint, which is formed by two bones, the astragalus *a*, and the tibia or shin-bone, allows the os calcis to rise, that is, the two ends of the gastrocnemius approach each other, since the muscle becomes shorter and thicker.

60. The **nervous system** consists of the **brain** and **spinal cord**, or **cerebrospinal system.** It is enclosed in a bony canal formed by the skull and spinal column, but leaving spaces or foramina for the passage of the cranial and spinal nerves, which are given off at regular intervals to the various parts of the body. There is a special set of nerves, already mentioned, which supplies the intestine, the heart and vessels, called the **sympathetic system.** It has connections with the brain and spinal cord. The spinal cord terminates above in the medulla oblongata, often termed medulla for the sake of brevity, after which follows the rest of the brain.

61. The **nerves** are white cords consisting of very fine fibres. If a rabbit be killed, and the skin of the back of the thigh cleaned off and the muscles separated, a white cord will be observed—the sciatic nerve—which, when cut or pinched, or in any other way stimulated, conveys an impression to the muscles of the leg, and produces a sudden movement or contraction. The **nerves** are therefore said to be **excitable organs**, while the **muscles** are organs of **contractility.** Besides these nerves going to muscles, others supply the glands, as the salivary glands, and when these are excited—that is stimulated—by a current of electricity, a secretion of saliva is produced. There is still another set of nerves which, when stimulated, convey impressions towards the brain and spinal cord, that is, in the inverse direction. Such nerves are called **centre-seeking**, that is **centripetal** or **afferent** nerves. The nerves of the eye (**optic**), thus carry impressions of various objects to the brain. In the same way vibrations of sound affecting the auditory nerve of the ear are carried to the central nervous system. The organ of smell (the nose),

of taste (the tongue), are also provided with similar centre-seeking nerves, called **olfactory** and **gustatory**. The skin itself is sensitive to touch or to a prick, and nerves which ramify in the skin carry impressions of touch and pain to the higher centres where they are perceived. The eye, ear, nose, and tongue and skin, are termed organs of sense. From the central nervous system nerves (which we have already mentioned) pass out again to the muscles (**motor nerves**) and to the glands (**secreting nerves**), which act in response to the impressions received by the organs of sense. Such nerves are called **efferent**. By means of the brain and spinal cord, and these two systems of nerves, the one centre-seeking or afferent, the other passing from the centres to the muscles and glands, the body is brought into relation with the objects of the surrounding world.

62. **Death, local and general.**—There are organs within the body on the functions and healthy working of which life most intimately and immediately depends. If the heart be injured, and permanently unable to perform its duties, death must follow. If the lungs are incapacitated so that the oxygen cannot enter the blood, asphyxia or death by suffocation results. So, too, if the spinal cord or brain be seriously damaged, especially that portion we have spoken of as the medulla, or if the circulation be cut off from them entirely for any length of time, death of the body at large is a necessary consequence. This is termed general death. There is another kind of death, however, which is continually taking place, namely, local or partial death. Thus hairs and feathers are constantly being shed; they have only a certain period of life, when they die and fall out. The serpent likewise periodically casts its skin, and the deer its antlers.

63. **Decay and putrefaction.**—When the general death of the body takes place, all the parts do not die simultaneously. The heart of the frog may continue to beat for hours after death of the animal, while the muscles, if kept moist and cool,

may contract, if pinched, after the lapse of days. But sooner or later the eye loses its lustre, the muscles become stiff, rigid, and dead, the blood thickens and decay becomes master. The soft parts are attacked bit by bit, particle by particle, and surely and silently dissipated into simpler and stabler substances. The carbon of the body leaves mainly as carbonic acid, the nitrogen as ammonia, and the sulphur as hydrogen sulphide (H_2S). The bones and hair are less perishable, but in the end they too

> 'Will surely one day to the dust return,
> And what the air has lent us, heaven will bear
> Away, and render back its own to air.'

CHAPTER VI.

THE BLOOD.

64. The blood is the red fluid contained within the heart and its vessels—arteries, capillaries and veins. A drop of blood may be obtained by pricking the finger with a clean needle. This is placed on a glass slide and covered with a small thin square of glass called a cover-slip, so as to spread it out into an even layer. To prevent coagulation a few grains of common salt are added, and to prevent drying, a drop of **normal salt solution**,* previously to placing on the cover-slip. When this has been done the slide is ready for examination under the microscope with a magnifying power of 300 diameters. It is seen at once that the blood is crowded with minute particles, which are called **corpuscles**. The great majority of these corpuscles possess a yellowish green tinge, are of a rounded form, and about $\frac{1}{3000}$th of an inch in diameter. Some of them will be seen edgewise; then

* Prepared by dissolving 6 grammes of common salt in a litre ($1\frac{3}{4}$ pint) of water.

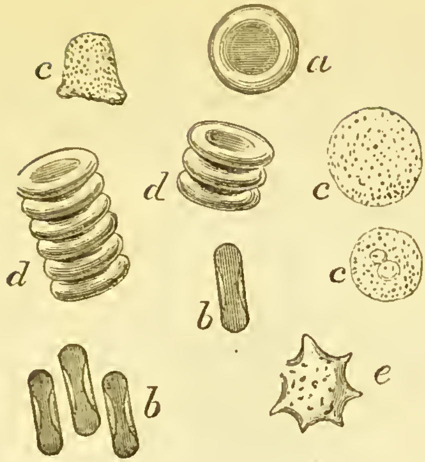

Fig. 43. Blood Corpuscles of Man : *a*, red corpuscle seen from the front ; *b*, edgewise ; *c*, *c*, white corpuscles ; *d*, *d*, red corpuscles in rolls ; *c*, star-shaped.

it is noticed they are somewhat thinner in the middle than at the circumference (*b*, fig. 43), and resemble minute dumb-bells. If seen in a thick layer, that is, superposed upon each other, they appear red. They are thus the cause of the red colour of blood, and are called the **red corpuscles.** Each is composed of a soft protoplasmic material, coloured by a substance termed **hæmoglobin.** Since their surfaces are somewhat sticky, especially after leaving the body, they easily adhere together and form **rolls** (*d*, fig. 43). When examined carefully they appear somewhat dimmer in the middle than outside. This is due to their thinness in the centre and not to the presence of a nucleus. No nucleus has been discovered up to the present. Since their bodies are **elastic,** the corpuscles, as they circulate in the capillaries, may often be seen to change their form in accordance with the size of the channel they are traversing. These changes are therefore not active but passive. On escaping from the capillary they resume their previous shape. This extraordinary property may be readily seen by pressing on the cover-slip, when the

red corpuscles assume an elongated shape (they do not break), from which they recover when the pressure is removed. Some of them may appear **star-shaped** (*e*). This is due to the action of the salt. The red corpuscles are so numerous that a cube of blood, the side of which measures $\frac{1}{25}$th of an inch, that is one millimetre, contains about 5,000,000. In the

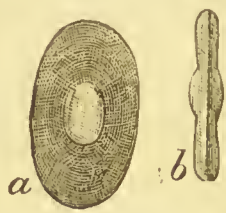

Fig. 44. The Blood Corpuscles of the Frog; *a*, from the front; *b*, in profile.

frog the red corpuscles are larger, possess a **nucleus**, and are somewhat **thicker** in the middle (fig. 44).

65. With care another kind of corpuscle may be observed. These are scarce and number only one to every 400 of the red, and they are **pale** and **colourless**. These are the **white corpuscles**. They are somewhat larger than the red, being on the average $\frac{1}{2500}$th of an inch in diameter; but they vary in shape, are nucleated, sometimes with two or more nuclei (*c*, fig. 43), and are more adhesive than the red. Their substance consists of protoplasm, containing in its interior granules of various kinds, and they possess the power of changing their shape—amœboid movement. They may wander out of the capillaries into the tissues around.

66. To show their power of movement an experiment has been performed in this way. A frog is chloroformed, and a small piece of the spongy pith (previously dried by being kept some time) of the elder tree is placed under the skin, and the skin sewn up again. After twenty-four hours the frog is again chloroformed and killed, the elder pith is removed, very fine

slices of it are made by means of a razor, and the slices or sections, as they are termed, examined under the microscope in normal salt solution. The white corpuscles will be found to have penetrated the pith, even to the very **centre.**

67. Besides the two kinds of corpuscles, white and red, with some difficulty other very minute bodies are discernible, much smaller than the other corpuscles, and called **blood-plates.** When blood is coagulating very fine threads appear to start from these plates and form a network which entangles the red corpuscles. These threads consist of **fibrin.**

68. **Coagulation.** When blood is allowed to flow from an animal into a basin it is at first perfectly fluid. In about five minutes, however, the blood becomes viscid and forms a jelly; in other words, it **coagulates.** After some little time drops of a yellowish fluid begin to appear on the surface of the clot, and these in the end run together to form a layer of fluid which is called **serum.** The blood is thus separated into **clot** and **serum.** If the **clot** be washed in a stream of water the colour gradually disappears, and thin strings of a whitish substance, called **fibrin,** are left behind. The process of coagulation, in fact, consists in the formation of fibrin, a solid substance which entangles the red corpuscles in its meshes and forms the clot. In the blood as it flows through the vessels fibrin does not exist, but is formed immediately the blood is shed.

69. **Conditions which influence Coagulation.** (*a*) A **low temperature,** as when the blood is kept in vessels surrounded by ice, prevents coagulation. (*b*) Also some substances, as a saturated solution * of sodium sulphate, or magnesium sulphate (Epsom salts), prevents coagulation when added to the blood. When this is the case, the

* A saturated solution of sodium sulphate is one in which the water used to dissolve this substance contains so much that it will take up no more.

corpuscles being heavier sink to the bottom, and a clear fluid may be obtained from the top, which is called the **plasma.** In this particular instance it is mixed with the salts added. When the plasma, so prepared, is diluted with water, it clots just like blood and forms **fibrin.** (*c*) The walls of the **living** blood-vessels exert a hindering influence upon coagulation, and the blood does not therefore clot within them, except in some cases where the walls are diseased.

70. Thus blood as it flows from the body consists of—

(*a*) **Plasma**	- -	{ **serum** / **fibrin**
(*b*) **Corpuscles**	-	**corpuscles.**

And the **plasma** consists when coagulated of **serum** and **fibrin.** The **clot**, as formed under ordinary circumstances, consists of **fibrin** with **corpuscles.**

In cases of inflammation the blood coagulates more slowly than usual. The corpuscles have greater time to sink, and when coagulation takes place the upper part of the clot is of a pale or buff colour, since it contains less of the red corpuscles. In the horse this buffed appearance is natural.

71. **Formation of Fibrin.** In the plasma three proteid bodies occur, viz., serum-albumin, which is soluble in water, and two globulins (paragraph 15—2), one of which is termed serum-globulin, and is present in the serum after the plasma has coagulated, and the other is fibrinogen, of which serum contains none at all. After death the fluid in the **pericardium** will not coagulate on removing it from the body, but it always contains fibrinogen, so that fibrinogen alone is not the sole cause of the formation of fibrin. But another substance has been prepared from blood which has been termed fibrin-ferment; and when this body is added to pericardial fluid, which, as we have seen already, contains fibrinogen, the formation of fibrin and a clot is the result. Again, when a vein containing uncoagulated blood is warmed to about 132° Fahrenheit, the fibrinogen separates from the

blood, and by no means whatever can the remaining blood be made to coagulate. Two substances are therefore necessary for fibrin to be formed and coagulation to ensue, namely, fibrinogen and fibrin-ferment. When blood is removed from the body the small plates (paragraph 65) probably break up into granules and set free fibrin-ferment into the plasma, which already contains fibrinogen; these unite and form fibrin.

72. The colour of the red corpuscles is due to the presence of a proteid substance termed **hæmoglobin.** It contains the usual elements of proteids and also iron. We shall have occasion to describe its properties more fully in Chapter VIII.

73. **Composition of the Blood.** As we have said, the blood consists of (*a*) **corpuscles**, (*b*) **serum**, and (*c*) **fibrin.** The red corpuscles make up about one-third the weight of the blood, the rest being **plasma.** Of fibrin there are about two parts in every 1,000 parts of blood. (*a*) The **red blood corpuscles** contain about half their weight of water. The solids are chiefly hæmoglobin. (*b*) The **serum** contains about 10 per cent. solids, of which the chief constituents are serum-albumin and serum-globulin.

Blood also contains from two to four parts of fat in 1,000; traces of sugar and urea, and six parts per thousand of sodium chloride: also traces of sodium phosphate, which imparts to blood its alkaline reaction, and calcium phosphate.

The gases contained in blood will be referred to in Chapter VIII.

The quantity of blood in body is about $\frac{1}{13}$th the weight of the body; that is, if the body weighs 154 lbs. there are about 12 lbs. of blood. Of this quantity about $\frac{1}{4}$th is always in the liver and $\frac{1}{4}$th in the muscles.

CHAPTER VII.

THE ORGANS OF CIRCULATION.

74. The heart lies in the thorax between the lungs (fig. 11). It is enclosed in a membrane called the **pericardium.** In shape the heart is conical, and lies rather obliquely; its apex being directed downwards and to the left, a little below the nipple and somewhat nearer the sternum. In this situation the apex can be seen and felt to beat between the fifth and sixth ribs. The heart is divided into two halves, right and left, and each half contains two cavities; the upper are termed **auricles,** the lower **ventricles.** Of these, the walls of the ventricles are much thicker and stronger, while the walls of

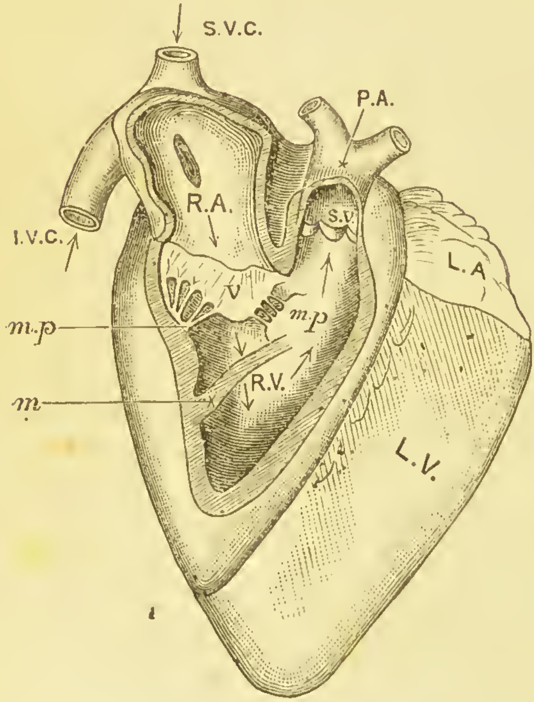

Fig. 45. Diagram of the Heart of the Sheep, with the Right Auricle and Ventricle opened, and seen from the front: I.V.C., inferior vena cava; S.V.C., superior vena cava; R.A., cavity of right auricle; V, one of the flaps of the tricuspid valve; *m p*, papillary muscles with their chordæ tendineæ; *m*, moderator band; R.V., cavity of right ventricle; S.V., semilunar valves at the base of P.A., the pulmonary artery; L.A., Left auricle; L.V., Left ventricle. The arrows represent the direction in which the blood flows.

the left ventricle are much thicker than those of the right. The structure of its fibres has been described in paragraph 48. The interior of the heart is lined, like that of the blood-vessels, by a very fine membrane called **endocardium.** When the right auricle is opened (fig. 45) two large veins are seen to open into it—these are the **superior** and **inferior venæ cavæ**—they bring back the venous blood to the heart from the body. Another opening is seen below, through which the finger may be pushed—this leads into the right ventricle; it is called the right **auriculo-ventricular** opening. When the right ventricle is opened, the latter orifice is more easily visible, and the right ventricle is seen to contain another opening which when followed leads into the **pulmonary artery.** The auriculo-ventricular opening, and that of the

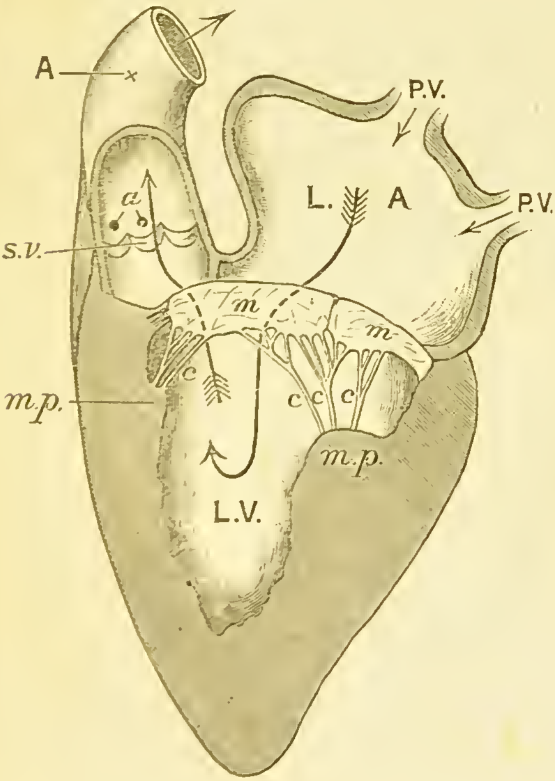

Fig. 46. The Left Auricle and Left Ventricle of a Sheep's Heart: *m*, *m*, flaps of mitral valve; *m p*, papillary muscles of the left ventricle, L.V.; *c*, *c*, *c*, chordæ tendineæ; A, aorta; S.V., semilunar valves of the aorta; *a*, *a*, openings of the coronary arteries just above the semilunar valves; P.V., two of the four pulmonary veins entering L.A., the left auricle. The arrows show the direction in which blood flows.

pulmonary artery, are guarded by flaps or folds called **valves.** When the **left auricle** is laid open with the knife (fig. 46) **five** openings are observed, four of which belong to the four pulmonary veins which bring back the blood from the lungs. The fifth opening is below, is larger, and communicates with the left ventricle. When the left ventricle is opened it also contains another orifice which leads into the **aorta**—called, therefore, the **aortic orifice.** The opening between the left auricle and left ventricle, and the opening between left ventricle and aorta are also provided with **valves.** The wall which divides the whole heart into right and left halves is termed the **septum.**

75. **The valves of the heart.** The valve between the right auricle and right ventricle consists of three cusps or flaps, hence its name **tricuspid.** Each flap is fastened to the orifice at one end; the other end is free. When the under surface is examined, a number of fine white cords (**chordæ tendineæ**) are seen, which, when followed downwards, enter small muscular projections of the wall of the ventricle, called **papillary muscles.** There are, therefore, three papillary muscles in the right ventricle. The cords are arranged thus:—Those passing from one papillary muscle do not all enter the

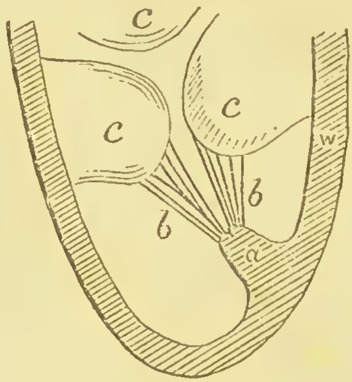

Fig. 47. Diagram of the Arrangement of the Chordæ Tendineæ; *a*, papillary muscle; *b*, chordæ tendineæ; *c*, flaps of tricuspid valve; *w*, wall of the right ventricle.

same flap, but pass to the adjoining sides of two flaps as in diagram 47. The valve between **left** auricle and ventricle has but two flaps, and from a resemblance to a bishop's mitre has been termed the **mitral valve**. There are, therefore, two papillary muscles on the wall of the left ventricle, and the chordæ tendineæ are arranged as on the right side.

At each of the orifices of the aorta and pulmonary artery three small valves are found, which, from their shape, have been termed the **semilunar** valves—sometimes the **sigmoid** valves. They form three little pockets or pouches, the openings of which are turned from the ventricle and look towards the aorta or pulmonary artery, as the case may be. They are formed like the auriculo-ventricular valves of the lining membrane — endocardium — strengthened with connective tissue.

76. The **arteries** divide and subdivide, becoming smaller, until they finally end in the capillaries. A large artery like that

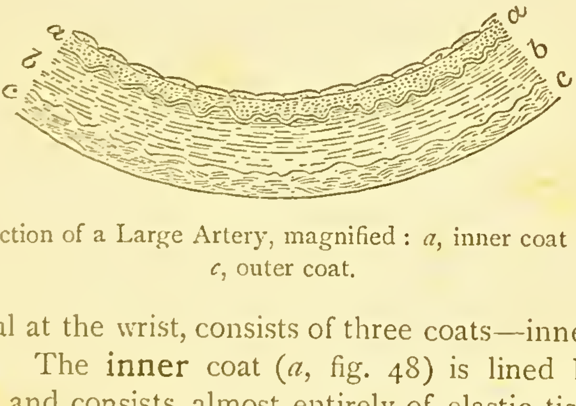

Fig. 48. Section of a Large Artery, magnified: *a*, inner coat; *b*, middle; *c*, outer coat.

of the radial at the wrist, consists of three coats—inner, middle, and outer. The **inner** coat (*a*, fig. 48) is lined by an endothelium, and consists almost entirely of elastic tissue. The **middle** coat contains both layers of elastic fibres and of muscular tissue (unstriped). The muscular fibres are arranged in the form of a ring around the artery. The **outer** coat is chiefly connective tissue.

In the minute arteries (fig. 49) just ready to break up into capillaries, there is also a lining of endothelial cells, but

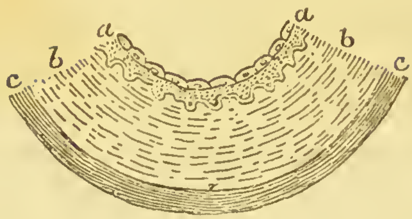

Fig. 49. Section of a Minute Artery, highly magnified : *a*, inner ; *b*, middle ; *c*, outer coat.

the inner coat is very thin as compared with the middle coat; the latter is composed almost entirely of annular muscular fibres, the outer coat is connective tissue. The great difference between a large and a minute artery consists in the relative amounts of elastic and muscular tissue. When the minute artery breaks up into capillaries the muscular and elastic fibres disappear, so does the connective tissue, so that only the endothelium remains. By means of a dilute solution of nitrate of silver the cells of the endothelium are rendered conspicuous, since the latter substance stains the substance

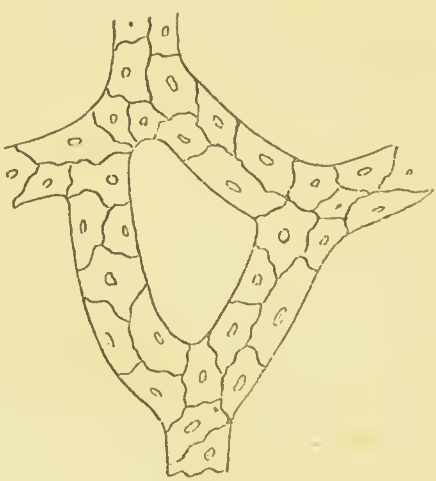

Fig. 50. Capillary stained with dilute solution of nitrate of silver, showing outlines of cells. Very highly magnified.

which cements the cells together of a black colour (fig. 50). These capillaries form networks with each other. In man the diameter of each capillary is about $\frac{1}{2500}$ of an inch. But they are somewhat smaller in the lungs and in muscle, and somewhat larger in the skin. The form of the network and its closeness also vary. In the lungs the network is exceedingly close, and the meshes or spaces between the capillaries are oval in form, whereas in muscle the meshes are long and narrow.

(*c*) The **veins** possess thinner walls than arteries, and less elastic tissue, so that while an artery remains quite open when it contains no blood, as after death, the veins collapse. Some veins, as the portal, contain a fair amount of muscular fibres. Many veins, particularly those of the limbs, possess small pouches termed **valves**. These are also folds of endothelium

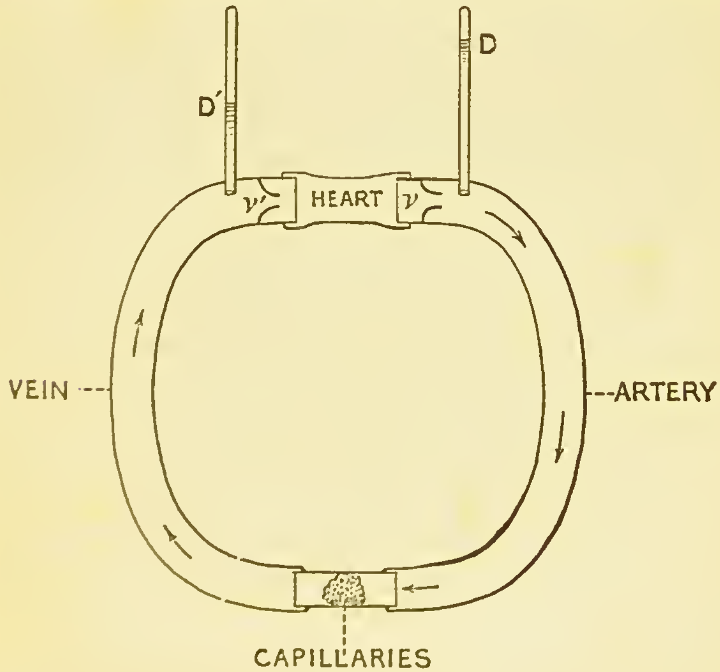

Fig. 51. Schema of the Circulation: *v*, semilunar, *v*[1], auriculo-ventricular valve; D, D[1], tubes to register the pressure of the fluid.

strengthened by elastic and connective tissue. The large veins, as the inferior and superior vena cava, the portal vein and its tributaries, have no valves.

77. We have now learnt the anatomy and histology of the heart, with its vessels, and must proceed to the working of the apparatus. To illustrate the action of the heart, and some of the fundamental facts of the circulation, models have been designed called **schemata.** A simple **schema** is represented in fig. 51. It is composed of elastic tubes. The ventricle of the heart is represented by a short piece of tubing, at each end of which is a valve ($v\,v^1$): v represents the auriculo-ventricular, v^1 the semilunar valves. As long as the fluid (water) flows in the direction of the arrows, v and v^1 remain open, but close immediately it attempts to flow in the opposite direction. The capillaries are represented by a short tube, in the interior of which lies a sponge. At the end of the vein and commencement of the artery, tubes D, D^1 are inserted to measure the height to which the water rises; in other words, the pressure. The tube representing the heart is compressed and relaxed by the hand at suitable intervals, say once every second. The equilibrium of the system is at once disturbed, the water in D rises, indicating a rise of pressure in the artery, and sinks in D^1. At every squeeze the fluid is sent through v, and every time it is released fluid enters the heart through v^1. Evidently, the **cause of the flow** is the **increased pressure in the artery** as compared with that in the vein. The object then of the heart, in the living animal, is to produce an increased pressure in the arteries, and induce thereby a movement of the blood from the arteries towards the veins, and the velocity of this flow will depend on the difference between the pressures in the arteries and veins. By means of the sponge, a **resistance** to the flow of blood, such as is found actually in the capillaries, is interposed.

78. Another kind of movement must be carefully distinguished. Every time a quantity of blood enters the artery,

the commencement of the artery dilates to receive it, and a **wave** or **undulation** of the wall of the artery, with its contained fluid, is produced and transmitted along the tubes with a velocity much greater than that of the blood itself. It travels as far as the capillaries where, as may be perceived by the finger, it becomes lost. This wave-motion is also readily seen on the surface of the water in *D*. It corresponds, as we shall see, to the **pulse**. The schema has, therefore, taught us the cause of movement of the fluid, and the difference between the velocity of the wave and that of the fluid itself.

79. **The work of Harvey.** At this stage, it will be profitable to describe the evidences of the circulation adduced by Harvey in the year 1628.

(1) Harvey first carefully observed the **order** of the movements of the heart when it was exposed in the living animal. He selected the hearts of cold-blooded animals, as serpents and frogs, because their hearts beat more slowly than those of warm-blooded. He noticed that the heart had periods of activity (**systole**), and periods of rest (**diastole**). When the ventricle is held in the fingers, at the time it contracts, it is felt to become suddenly quite hard, just like the muscle of the arm when it contracts. Harvey was the first to connect the cause of the circulation with muscular action, and he saw that the **systole** or contraction of the heart was the leading event. He noticed the two auricles contract at the same moment, and before the ventricles. They must, therefore, fill the ventricles with blood; then the ventricles contract and must drive blood into the arteries.

(2) When the blood is cut off from the arteries by a ligature they no longer pulsate—the pulse of the arteries is, therefore, due to the beat of the heart, and they do **not** beat of their own accord.

(3) In another line of argument the **quantity of blood** which leaves the heart at each systole was calculated. His figures were erroneous, but the method was quite correct.

When the amount of blood within the body is divided by the amount of blood sent out at each beat, it is found that in about 27 beats—20 seconds—the whole of the blood will pass through the heart. Hence, as Harvey said, the blood must of necessity come back into the veins and enter the heart again after leaving it; in other words, **the blood must circulate.**

(4) Harvey then placed **ligatures** around the limbs. If he tied the cord very tightly he could stop the blood from entering the limb altogether, and the pulse too; but if tied not so tightly the circulation in the veins only, was obstructed, since their walls being thinner more readily collapse; and they also, as a rule, run more superficially. Since the circulation in the arteries, in the latter case, is uninterfered with, the veins on the heart side of the ligature become empty, but on the other

Fig. 52. The Veins at the Front of the Elbow: *a*, the median vein.

side they begin to swell. The same is seen by pressing hard with the thumb on one of the veins at the elbow (*e.g.* *a*, fig. 52), when the vein as far as the wrist fills with blood; and if the thumb be pressed downwards along the vein towards the hand

one or more swellings will be noticed in its course, which are the **valves**. Cæsalpinus, an Italian, had indeed some years before Harvey used the term "Circulation." He thought that **probably** the veins carried blood **to** the heart, since, as he said, when the veins are pressed upon they swell on the side furthest away from the heart. It is to the immortal credit of Harvey that he submitted the whole question to the test of **experiment**, so that he not only rendered the fact of the circulation probable but actually **demonstrated** it. Harvey did not know anything of the capillaries, and, therefore, could not say how the blood in the arteries reached the veins. A few years after his death, however (in 1661), Malpighi, of Bologna, by means of the microscope, not only saw the capillaries but the blood and blood-corpuscles moving within them. Subsequently, it was shown that though the blood circulates within closed vessels the walls of the capillaries are delicate and allow the plasma to pass through into the tissues.

80. **Action of the heart and its valves.** Each action of the heart occupies about a second. The contraction of the ventricles lasts about $\frac{1}{3}$ of a second, during the remaining two-thirds it rests (**diastole**). During this time, however, it is filling with blood. The contraction of the auricles lasts $\frac{1}{10}$ of a second, and during the remaining $\frac{9}{10}$ they receive blood from the two venæ cavæ on the right, and from the pulmonary veins on the left side. When the ventricles contract their object is to lessen their cavities, or even obliterate them altogether and thus drive blood into the arteries. At the same time they

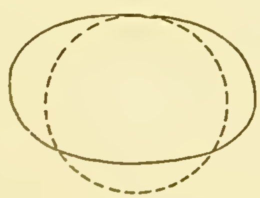

Fig. 53. The Change of Form of a Transverse Section of the Heart. The continuous line represents the shape in diastole, the dotted in systole.

change their external form. Thus while a transverse section during **diastole** is of an elliptical shape, during **systole** it becomes circular (fig. 53), the ventricle is jerked against the wall of the chest and the **impulse** or beat, felt externally, is produced. When the auricles contract the contraction starts **from** the mouths of the great veins which enter them, and sweeps over the auricular surface. The blood is, therefore, driven into the ventricles, which immediately commence to contract. The blood gets into the ventricles, sweeps around the interior, and floats up the flaps of the auriculo-ventricular valves a little, and, as the ventricles begin to contract, the pressure of the blood raises the flaps still higher so that their edges come together. As the ventricles go on contracting the valves tend to **bulge** into the auricles, but at the same time the **papillary muscles** contract and keep the edges in close approximation, and thus hinder the reflux of blood. At length the pressure of blood within the ventricles becomes so great that the **semilunar valves** are burst open, and the contents are delivered into the pulmonary artery and aorta respectively. It is a question whether the ventricles empty themselves completely. Experiments have been made which show that in the left ventricle of the **rabbit** (*Lancet*, October 26, 1889) a small quantity of blood is usually left behind. As the strength of the ventricle relaxes the blood tends to rush back into them; this is **prevented** by the three pouches of the semilunar valves filling out, coming together, and interposing an effectual barrier.

81. The rapidity of the heart's action varies. In the horse it is very slow, in man it is about 70 beats per minute, while in the dog it is much quicker. When the ear is placed over the heart, a constant repetition of two **sounds** is heard for each beat. These resemble the words **lūbb, dŭp**, since the first is somewhat long and heavy, and the second is short and sharp.

The **first sound** is produced by the contraction of the muscle of the heart itself. A sound is always produced when

a muscle contracts—the sudden tightening of the auriculo-ventricular valves may contribute a little, but by special precautions these valves have been prevented from closing, in the living animal, and no difference in the sound is perceptible. On the other hand the second sound is due to the sudden tightening of the semilunar valves at the moment the blood attempts to rush back into the ventricles, since after throwing them out of action, as by hooking one of them back, the sound ceases.

82. **The circulation in the arteries.** When an artery divides, the area of the branches together exceeds its own, so that the capacity of the arterial system increases with the distance from the heart, and the stream will lose in velocity, just as a river diminishes in velocity when its bed is widened. Moreover the larger arteries possess a considerable amount of **elastic tissue** in their walls. Hence they are not rigid unyielding tubes, but they are distended and expanded by the blood. The influence of this elasticity upon the character of

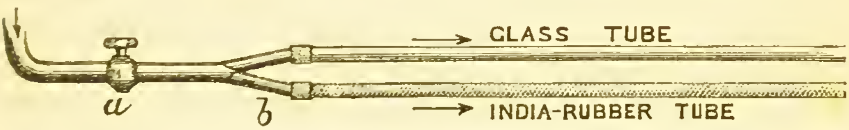

Fig. 54. A simple Apparatus to show the Influence of Elasticity on the Flow of a Liquid : *a*, water-tap.

the flow is readily seen by means of a simple experiment. By means of the branched tube *b* *Fig.* 54, connection is made between the water tap *a* and the indiarubber and glass tubes. The water is then turned on and off at intervals of about a second, and the water runs from the glass tube in jets, but from the indiarubber tube, if long enough, in a continuous stream. In the same way the left ventricle sends a quantity of blood into the aorta at each stroke. The aorta is already full, so the first part of the tube must dilate to receive this additional amount. The wall is therefore stretched, and this movement

is carried on as a **wave** through the arteries and is felt as the pulse at the wrist. But the wall of the artery being elastic tends to recover its shape (before the next stroke of the heart) just like a stretched piece of indiarubber does; it contracts,

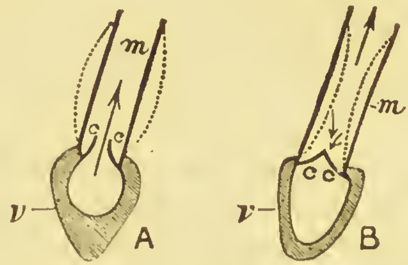

Fig. 55. Diagram of the Aorta and Left Ventricle: A, ventricle in systole; B, in diastole; *m*, aorta; *c*, *c*, semilunar valves. The dotted lines represent expansion (A), and subsequent recoil (B) of the aortic wall.

therefore, and pushes the blood onwards, since the semilunar valves are closed (fig. 55). If a moderately large artery be cut the blood flows out in jets, but as the arteries become smaller the current becomes more equalised, until in the capillaries the current is perfectly uniform. This property of elasticity is purely **physical** and is therefore possessed by the arteries after death.

83. **The Circulation in the Capillaries.** The blood can be seen to circulate in the capillaries by the microscope in parts of the living body which are transparent or thin. Thus the web of a frog's foot, the wings of bats, or the tails of tadpoles are suitable. It has also been observed in the everted lip of man himself. The red corpuscles lie in the middle or **axis** of the stream, leaving a clear layer between the red line they themselves form and the capillary wall. This is the case except in the very narrowest capillaries, where the red corpuscle must elongate in order to squeeze through. The velocity of the fluid in the clear outer layer is less, (*a a* fig. 56) on account of the **friction** against the walls. The white

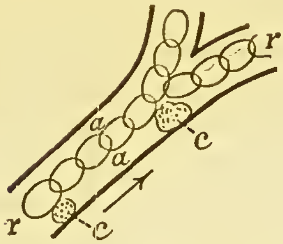

Fig. 56. The Circulation in a Capillary: *r*, row of red corpuscles; *c*, white; *a*, *a*, quiescent layer.

corpuscles lie in this more quiescent layer, and may often be seen to stick to the walls of the capillary, and in some cases to penetrate it. On account of the elasticity of the arteries, and the resistance afforded by the capillary walls, the systole of the heart is not apparent in the capillary stream, for the latter is quite regular. Also the pulse is lost, since the waves which start from the commencement of the aorta are divided into so many arterial branches that the effect is lost at the capillaries. While the velocity of the stream of blood in the aorta is one foot per second, in the capillaries it is not more than one inch per minute.

84. **The circulation in the veins.** The pressure in the vessels is greatest in the arteries, becomes less in the veins, and in the right auricle it may be *nil*. Since the pressure in the capillaries is greater than in the veins, and greater in the veins than at the auricles, the blood flows from the capillaries into the veins, and thence towards the heart. Some of the veins

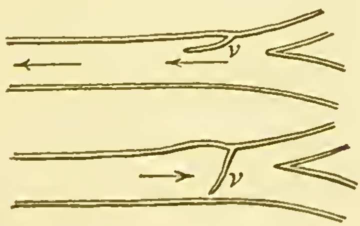

Fig. 57. The Valves in the Veins, *v*, *v*.

are provided with valves, which only permit the blood to flow towards the heart, preventing any regurgitation (fig 57). The time for a complete circulation occupies about 27 beats or 20 seconds. The **shortest** course possible is through the **coronary** arteries (which are given off by the aorta just above the semilunar valves) to the muscle of the heart itself (these arteries can be observed ramifying over the exterior of the heart). The blood is collected by the **coronary** vein which enters the right auricle by a separate opening. Although the speed in the capillaries is so slow, the actual extent of capillary traversed by the blood in a single circulation is very short.

85. The various emotional states may **affect** the beating of the heart; thus, sudden joy or excitement may render the beats quicker, and terror may stop the heart altogether. At the same time the condition of the vessels may be materially influenced, so that blushing or pallor may be the result.

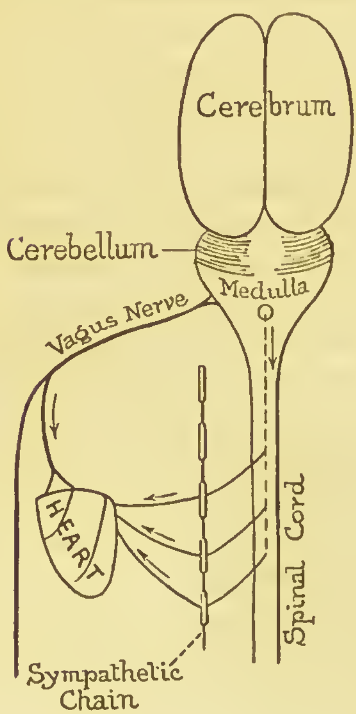

Fig. 58. Diagram of the Nerves of the Heart.

Blushing is due to a local dilation of the smaller arteries; the blood supply, therefore, is increased and the part becomes warm and red. Pallor is due to the opposite state of things. The heart is supplied by two sets of nerves, the **pneumogastric** or **vagus nerve**, and the **sympathetic**. The **vagi** spring directly from the medulla oblongata, while the **sympathetic** pass down from the medulla into the spinal cord, and reach the heart through the sympathetic chain (fig. 58). In 1845, E. Weber, a German physiologist, and his brother, showed that by stimulating the vagus nerve, the heart may be **stopped**. This is called **Inhibition**: that is, a restraint. The effect of this nerve is seen in what physicians term **shock**. When a person receives a serious injury to the limbs, or abdomen, or a serious fright, he may die from shock: that is, the painful impressions are conveyed to the medulla, reflected down the vagus, and stop the heart. The nerves coming from the **sympathetic**, on the other hand, when stimulated, **accelerate** the heart.

86. We have already referred to the muscular coats of the smaller arteries. This layer of muscle is supplied by very **fine** nerves, originally springing also from the medulla oblongata. In 1852, Claude Bernard discovered that when the **sympathetic** nerve in the neck of a rabbit is cut, the ear of that side becomes red, and the arteries could be seen to become larger. When he stimulated the nerve by an electric current, the ear became pale as before. These nerves are called **vaso-motor nerves**. By their means the arteries are kept always slightly constricted. But there are two kinds of these nerves; some when stimulated constrict the arteries still further (**vaso-constricting** nerves) while others dilate the arteries, (**vaso-dilating** nerves). The smaller arteries therefore possess **vital contractility**, by virtue of their unstriped muscle and nerves.

87. It is only under certain circumstances that a **capillary pulse** is to be seen. When the smaller arteries dilate under

the influence of the nervous system, the blood may pass through the capillaries into the veins in a pulsating stream, and the waves of the pulse with them. This is due to dilatation of the smaller arteries and a diminution of the resistance to the blood flow.

88. The cause of the **rhythmical action** of the heart is still obscure. Besides the vagus nerves and the sympathetic the heart possesses a number of ganglia and nerves of its own, and it has been thought that the rhythm of the heart is due to their influence. But since even strips cut out of the ventricles, after death, of animals like the tortoise may beat hythmically, and these strips possess no nerve cells, it is more probable that we must look upon the rhythm as a property of the muscular fibres of the heart themselves, just as the power of spontaneous movement is a property of the protoplasm of the white blood corpuscles.

CHAPTER VIII

RESPIRATION.

89. The act of respiration is necessary in order to provide for a constant replenishment of oxygen, and to release the excess of carbonic acid which the blood of the pulmonary artery contains. The apparatus consists of the chest and ribs, with their muscles, the trachea or windpipe, the bronchi and lungs.

90. The chest consists of an **osseous** framework. Behind is the **backbone,** at the sides the 24 **ribs,** which pass forwards

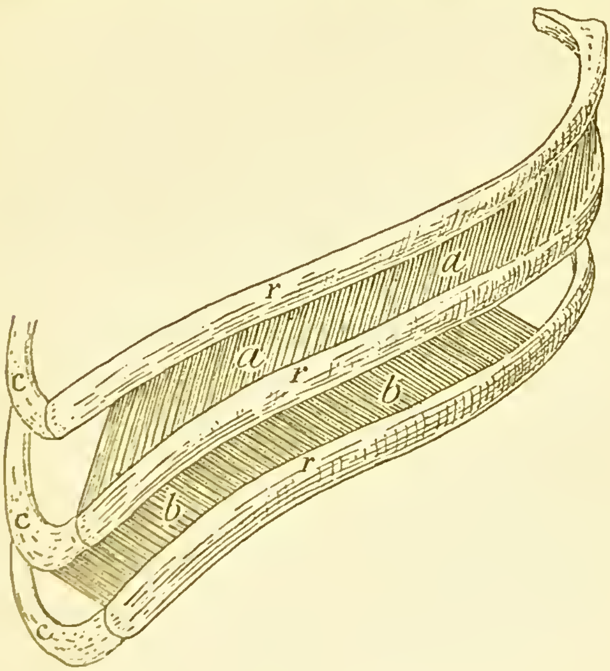

Fig. 59. A Diagram showing the direction of the External Intercostal Muscles, *a*, *a*; Internal Intercostals, *b*, *b*; *c*, *c*, Costal Cartilages; *r*, *r*, Ribs. The space between *c* and *b* should have been completely filled with muscular fibres of the internal intercostal muscles.

to be united to the sternum by means of the **costal** cartilages. The latter are elastic and flexible. Between the ribs, and filling up the intervening spaces, are muscles, called **intercostal** (fig 59). Of these muscles there are two layers, the outer of which are called the **external intercostals**. These consist of short fibres (the length of an intercostal space), which run diagonally from behind forwards. They commence behind, and cease at the cartilages. The **internal intercostals** run in the opposite direction (*b*, fig. 59), fill up the spaces between the costal cartilages, but they

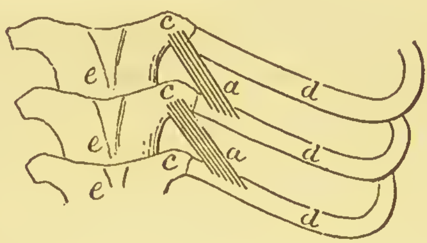

Fig. 60. A Diagram of the Action of the Levatores Costarum: *e*, *e*, posterior surfaces of the vertebræ: *c*, *c*, transverse processes; *a*, *a*, levatores costarum; *d*, *d*, ribs.

do not reach so far behind as the external intercostals. Other muscles (*a*, fig. 60) pass from the transverse processes of the vertebræ to the ribs close to the backbone. These are called **levatores costarum**. There is also a bundle of muscles on each side of the neck, passing from the transverse processes of some of the cervical vertebræ to the **first** and **second ribs**, called the **scaleni** muscles (M, fig. 61). Other muscles pass from the shoulder blade to the ribs. Forming the **floor** of the thorax, and separating it from the abdomen, is the **diaphragm**. We have already said that its central part is tendinous, while the sides, all round, are muscular. These muscular fibres are inserted into the lower six ribs. There are **three** openings in the diaphragm—one for the inferior vena

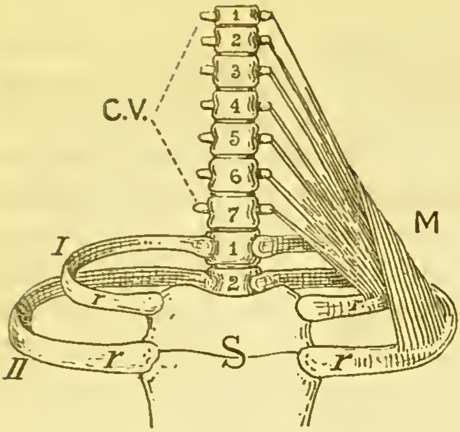

Fig. 61. Diagram of the Left Scalene Muscles, M: C.V., cervical vertebræ; I., II., 1st and 2nd ribs; S, sternum; *r*, *r*, costal cartilages joining sternum.

cava, one for the œsophagus, and one behind for the aorta and thoracic duct.

91. The cavity of the thorax is occupied chiefly by the lungs, lined by the pleura, and the heart lying between them (fig 9A). When the **trachea** reaches the chest it divides into two branches called **bronchi**, one for each lung. In the lungs the

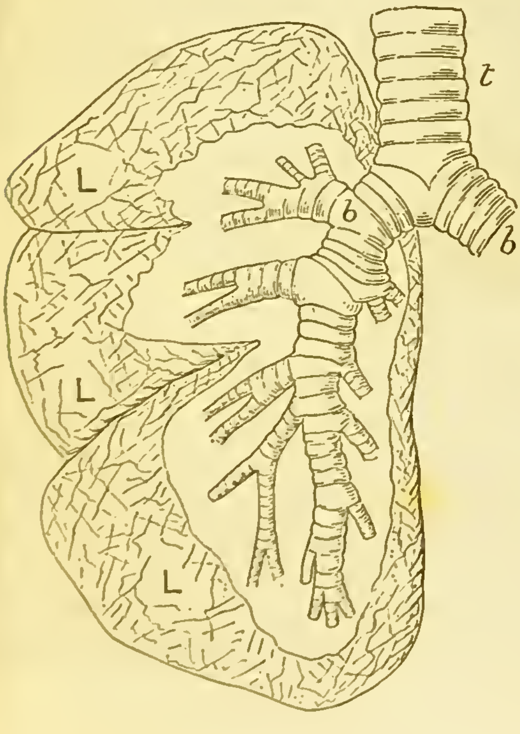

Fig. 62. The Branching of the Bronchus within the Lungs: *b*, bronchus; *t*, trachea; L, lung.

bronchi divide and subdivide (fig. 62), until, when each tube has reached a diameter of $\frac{1}{25}$ of an inch, it begins to end in very minute delicate pouches, each $\frac{1}{100}$ in. diameter, called the **air-cells** or **air-vesicles**. The interior of each air-vesicle, therefore, communicates with the trachea. Air may be taken in by the nose or by the mouth. In the former case it reaches the pharynx through the posterior nares, and then passes through the glottis (this is the space left between the vocal cords) into the larynx, and thence into the trachea and bronchi.

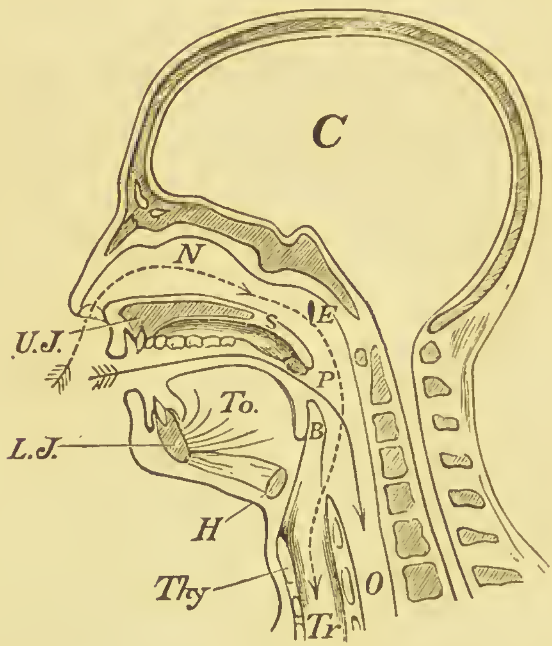

Fig. 63. A Diagram to show the Passage of Air through the Nose: U.J., upper jaw; L.J., lower jaw; N, cavity of nose; P, pharynx; S, soft palate; E, opening of Eustachian tube; B, epiglottis; Thy., thyroid cartilage; Tr., trachea; To., tongue; H, hyoid bone; O, œsophagus; C, cavity of cranium. The proper direetion of the inspired air is represented by the arrow in dotted line.

The branches of the bronchi carry it to the air-vesicles (fig. 63). It has been calculated that they number above five millions,

and over each is spread the finest network of capillaries within the body.

92. **The trachea** consists of a number of rings of cartilage, which are incomplete behind. Internally these rings are lined by mucous membrane, the epithelium of which consists of two or three layers, and the most superficial layer consists of **ciliated** cells (fig. 18). The bronchi have a similar structure, but as they divide in the lungs and become smaller, they gradually lose their cartilage, although they retain their ciliated epithelium until they end in the air-vesicles.

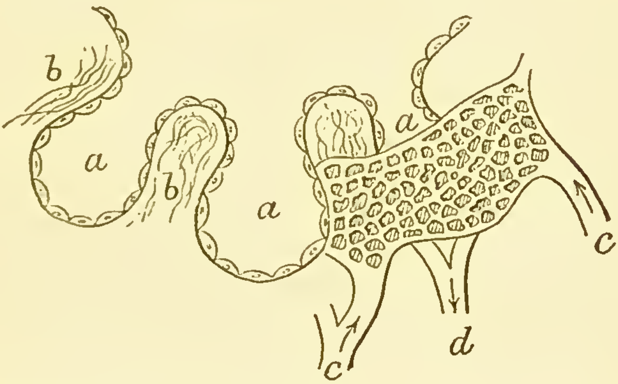

Fig. 64. Diagram of Air Cells, highly magnified to show network of Capillaries: *a*, *a*, *a*, air vesicles; *b*, *b*, elastic fibres; *c*, *c*, terminal branches of the pulmonary artery; *d*, commencement of pulmonary vein.

The latter are lined by **flat** cells, and their walls are strengthened by elastic tissue (fig. 64). The pulmonary arteries end in the capillaries spread out just beneath the air cells, and the blood is gathered together again by the pulmonary veins. It is therefore plain that each lung consists of a mass of bronchial tubes and air-vesicles—hence its spongy nature—as well as of arteries, capillaries, and veins.

93. Since the chest is an air-tight cavity, air can only enter the lungs by the trachea. It is possible to enlarge the cavity

of the chest in three directions—either from side to side (**laterally,** that is transversely), from front to back (**antero-posteriorly**), or longitudinally. When the walls of the chest expand (since one layer of the pleura lines the wall, and the other is firmly united to the lungs, and the **two** layers of the pleura are in contact by adhesion, and can move upon each other readily), the lungs must enlarge as well. The air-vesicles, therefore, enlarge, and air must enter from the outside to fill the increased space. When the muscles which have enlarged the chest cease to contract, the ribs being elastic and the lungs containing elastic fibres in abundance, the chest and lungs lessen again in capacity, and air is driven out or expired. Whereas **inspiration** is due to **action of muscles** enlarging the capacity of the chest, **expiration** when quiet and natural is an effect of **elastic recoil.**

94. The chief muscle of inspiration is the **diaphragm.** So important is it, that **Haller,** a physiologist of the last century, termed it 'musculus post cor nobilissimus,' that is, after the heart the most essential muscle in the body. When it contracts, it increases the longitudinal diameter of the chest.

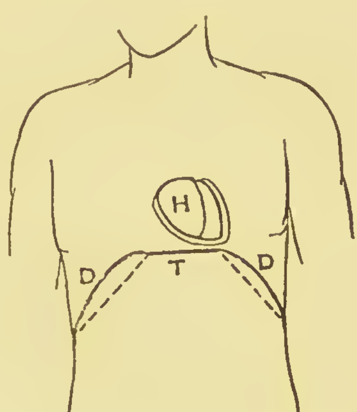

Fig. 65. Diagram of the Diaphragm: H, heart; T, tendon of diaphragm; D, D, its muscular fibres. The dotted lines show position of these fibres during inspiration.

In fig. 65, T is the centre, which is tendinous and forms its fixed point. Since the heart lies on the upper surface and is connected with it, the importance of the centre remaining firm will be seen at once. As the muscle contracts, the curved line of the muscular fibres becomes straighter, and so the cavity enlarges. In thus descending, the diaphragm presses on the stomach and liver, and causes a heaving of the abdominal wall. This movement is more marked in men and children than in women.

95. Other muscles, which are effective inspiratory muscles, are the **scaleni** and the **levatores costarum**. Since the cervical vertebræ form a fixed point, when the scaleni contract they elevate the 1st and 2nd ribs, and consequently the lower ones with them, since they form one continuous connection, and at the same time the sternum is elevated and pushed forwards. The antero-posterior diameter is thereby increased. Also the ribs, as they are elevated, straighten their natural curves so that the **transverse** diameter is also enlarged. The levatores costarum act at a short leverage (fig. 60), but the combined action of all amounts to something considerable. When the finger is placed on the scaleni, they can be felt to contract during inspiration, especially in thin persons. The contraction of the levatores costarum cannot be perceived in men, since they are covered by several layers of muscles; but in rabbits they may be seen to raise the ribs, even after removing all other muscles.

96. The muscles between the ribs—**intercostal**—are supplied by the intercostal nerves. The **external** intercostals elevate the ribs, and are, therefore, **inspiratory** muscles. For let *ab* represent the direction of one of the fibres. When the muscle acts as an elevator of the lower rib, as in fig. 66, the force may be resolved into two, one of which, *bd*, has no influence on the rib; but *bc* then acts at much greater leverage than does the force a^1c^1 in fig. 67, in which the muscle is supposed to act in the opposite direction. The force *bc* would,

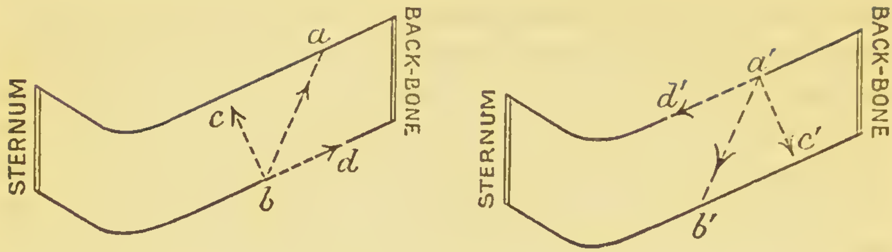

Fig. 66 and fig. 67. Diagrams of the External Intercostal Muscles.

therefore, overcome a^1c^1 and the rib would be elevated. A similar method of reasoning shows that the **internal** intercostals **depress** the ribs or are muscles of **expiration.** We must except, however, that portion of the internal intercostal muscle which lies between the costal cartilages (figs. 68 and 69).

In this case the movable points are at n and p, where the cartilages mn and op join the ribs. The force a^1c^1 in fig. 69 acts at a greater leverage than bc (fig. 68), and is hence the

Fig. 68 and fig. 69. Diagram of that portion of Internal Intercostal Muscles which lies between the Costal Cartilages.

effective one. But when a^1c^1 contracts it tends to straighten the curve at n and p, that is, it just does what the external intercostal tries to do. The sternum must be pushed forwards. This portion of the internal intercostals is therefore **inspiratory.** The intercostal muscles do not, however, come much into play during ordinary quiet respiration.

97. When from any circumstance, as disease, the entrance or exit of air is impeded, a number of other muscles come

into action, called **extraordinary** muscles of respiration, that is, muscles which are not used in ordinary or quiet breathing. So after active exercise additional muscles are called into play, since an increased quantity of carbonic acid must be eliminated and an increased quantity of oxygen inhaled. The shoulders and arms, in disease of the lungs, are often held stiff, so that the muscles which pass from chest to arm, and usually move the arm, can now act in the reverse direction and enlarge the chest. In the same way the muscles of the neck are seen to contract powerfully. In these cases expiration, too, is not simply an elastic recoil, but is also aided by the abdominal muscles, which press upon the stomach and liver, and so push back the diaphragm into its previously curved position. If the deficiency of oxygen continues, **asphyxia** or suffocation is the result. The stage of increased respiration, or **dyspnœa,** passes into convulsions, the face and lips become livid, and death is the end. In these cases the blood in the pulmonary artery cannot obtain sufficient oxygen, so that the blood of the pulmonary **veins** is no longer arterial but **venous.** After death the right side of the heart and the veins are found engorged with blood. It is probable that the blood, being excessively venous, paralyses the muscle of the heart.

98. The blood driven into the lungs is **venous blood,** that which leaves them by the pulmonary veins and passes to the left auricle is **arterial.** Venous blood is darker than arterial, and contains more carbonic acid and less oxygen. The venous blood enters the lungs, and is spread out in the capillaries, which are extremely fine channels, so that the blood moves through them but slowly. Only a very fine membrane, consisting of the epithelium of the air-vesicles, separates the blood from the oxygen contained within them. The **hæmoglobin** of the red blood corpuscles has an affinity for oxygen, and has opportunity to satisfy itself; while some of the carbonic acid present in the plasma passes into the air-

vesicles to be expired. By what means the carbonic acid leaves the plasma is not yet finally settled. When a gas, like CO_2, is dissolved in a fluid like the plasma, and the plasma containing CO_2 is then exposed to an atmosphere which also contains some CO_2, if the quantity (or **tension**, as it is termed) of the CO_2 in that atmosphere is very small, the plasma, which contains a fair amount of CO_2, suffers an escape of that gas, which passes into the atmosphere in contact with the plasma. The converse also holds, and the gas is said to **diffuse**. But blood as it moves along the vessels, gives up little CO_2 even to an atmosphere containing only traces of this gas. The agency of the epithelium of the air-vesicles has been invoked as a solution of the problem.

99. The bright arterial blood leaving the lungs is distributed over the body. All the tissues, especially the muscles, are **poor** in oxygen, and therefore have a great avidity for it. This effect makes itself felt through the capillary walls, the plasma, as far as the hæmoglobin of the red corpuscle. The latter is unable to keep its oxygen supply, but liberates some proportion as it rushes past. The hæmoglobin has therefore been called the **oxygen carrier.** It may be demonstrated under the microscope that living cells are able to reduce hæmoglobin in a similar manner. As a result of oxidation in the tissues CO_2 is produced, which again reaches the blood by traversing the lymph stream or by diffusing through the capillary wall.

100. When a vein is opened, as in the operation of blood-letting, the dark red fluid oozes out, and on exposure to air becomes brighter and more like arterial blood. The hæmoglobin **absorbs oxygen** from the atmosphere. By adding a reducing substance to blood, contained in a glass vessel or test-tube, the colour of the blood may be re-darkened. As reducing agents, sulphide of ammonium or a solution of green sulphate of iron may be used. The outside of a large blood

clot is always brighter than its interior, since the oxygen of the air is unable to penetrate to any great distance.

101. **Composition of inspired and expired air.**— The composition of inspired air is that of the atmosphere. In expired air the quantity of CO_2 is 100 times as great as in inspired air. Moreover, the oxygen is less in amount. Expired air always contains much **aqueous vapour.**

	Inspired Air.	Expired Air.
Nitrogen	79 parts per 100 ...	79 parts per 100
Oxygen	21 ,, ,, ...	16 ,, ,,
Carbonic Acid ...	4 parts in 10,000 ...	4 ,, ,,

102. **Breathing** consists of an inspiration, followed by an expiration, and then a pause. About 30 cubic inches of air are inspired at each breath. This is called **tidal air,** since the same quantity leaves at the next expiration. By making a greater effort as many as 90 cubic inches more may be **inspired.** Also about 90 cubic inches more may be **expired** by muscular exertion. When an individual fills out his lungs as much as he can, and then empties them as much as possible, the amount therefore is 90 + 90 + 30 = 210 cubic inches. Dr. Edward Smith devised an instrument to measure this. It is simply a gas-holder, and called a **spirometer.** The amount just given was called the **vital capacity.** This varies with the height of the individual, and with the measurement of his chest. One inch of height, or one inch of circumference, makes a difference of about 10 cubic inches. After the greatest effort there is still some air in the lungs, which is called **residual air.** It amounts to about 90 cubic inches. This is the reason why the lungs of animals which have breathed are light and float on water. The lungs are known commonly as the **lights.**

103. As the tidal air is therefore only about $\frac{1}{10}$th the quantity of air in the lungs it never reaches the air-vesicles. But the oxygen it contains diffuses gradually through the more

internal layers, just as the carbonic acid diffuses outwards. The tidal air being 30 cubic inches, and the CO_2 being 4 per cent., 1·2 cubic inches are exhaled at each breath. Since we breathe fifteen times a minute, the amount of CO_2 per day is $1 \cdot 2 \times 15 \times 60 \times 24 = 26{,}000$ cubic inches per diem, or 12,000 grains, nearly 2 lbs. During the same time about 9 ounces of water are given off by the lungs. Now, it is a rule in hygiene that the CO_2 of inspired air should not exceed $\frac{1}{10}$th per cent., since then it becomes unwholesome. The average man loads 30 cubic inches of air to the extent of 4 per cent. at each breath, that is, 1,200 cubic inches to the extent of $\frac{1}{10}$ per cent. He breathes fifteen times a minute, so that he will vitiate 1,000,000 cubic inches per hour, or about 600 cubic feet. He should therefore be supplied with this quantity of fresh, pure air per hour.

104. **Influence of respiration on the circulation.** The lungs are enclosed in an air-tight cavity, and their elastic tissue, even under ordinary circumstances, is slightly stretched. This is seen on making an opening into the pleura of a dead animal; the lungs collapse at once by virtue of their elastic fibres. Since the pleura is attached to the pericardium, the slight tension of the lungs must exert a traction on the heart and vessels in the thorax, and the latter will therefore be subjected to a less (minus or **negative**) pressure than the blood-vessels of the rest of the body. During inspiration, when the elastic tissue is rendered still tenser, this **negative pressure** increases, and the effect is the same as if a partial vacuum existed in the space between the lungs. The blood tends to rush back into the chest, but the effect is of course most evident on the thin-walled veins, since the coats of arteries are thicker and more resistent. The venous flow into the right auricle is facilitated. Moreover, during inspiration the pressure upon the capillaries of the lungs being slightly less than in expiration, they dilate somewhat, and offer less resistance to the flow of blood. These two factors lead during

inspiration to a stronger beat of the heart, and an **increased pressure** in the arterial system.

105. **Nervous mechanism of respiration.** The medulla oblongata contains a certain area, called the **respiratory centre,** since when this area is destroyed respiration stops. It is situated close to the spot where the two pneumo-gastric or vagus nerves enter it. Each vagus sends a branch to the lung of its own side, called **pulmonary** (fig. 70). The

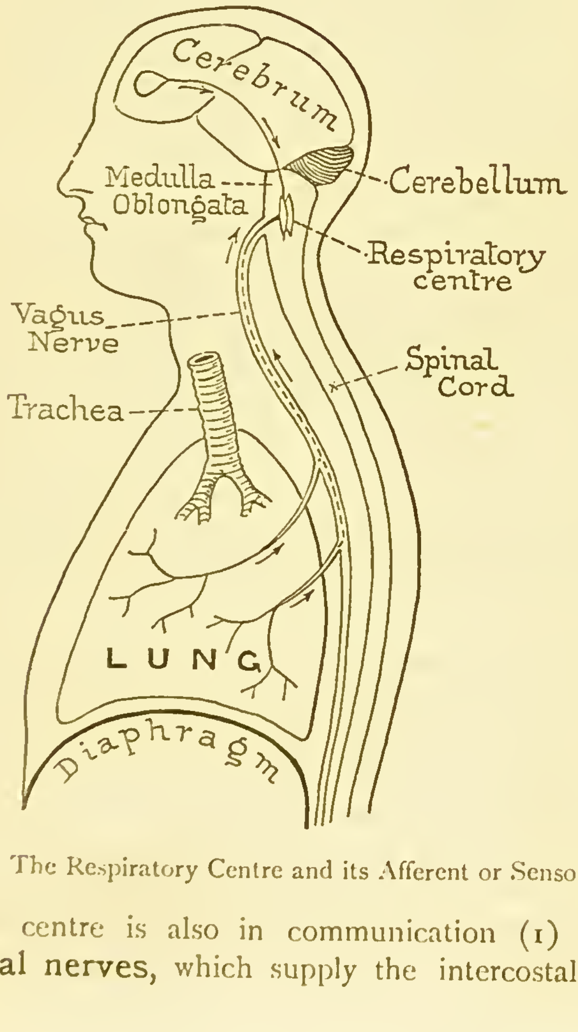

Fig. 70A. The Respiratory Centre and its Afferent or Sensory Nerves.

respiratory centre is also in communication (1) with the **intercostal nerves,** which supply the intercostal muscles,

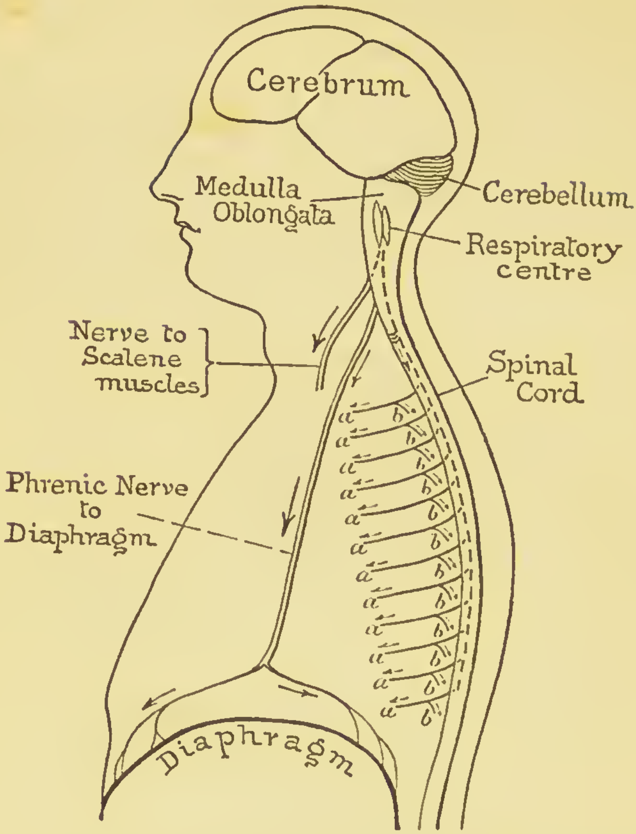

Fig. 70B. The Respiratory Centre and its Motor or Efferent Nerves: *a*, *a*, *a*, nerves to intercostal muscles; *b*, *b*, to levatores costarum muscles.

(2) **the phrenic nerves**, which go to the diaphragm, and (3) nerves going to **scaleni** and **levatores costarum** muscles. The centre sends out inspiratory impulses—about 15 a minute—which cause all these muscles to contract in unison, and thus dilate the chest cavity. If the phrenic nerves are cut the diaphragm stops and the animal dies. These nerves are therefore the **motor** or **efferent** branches of the respiratory centre. The same occurs when the nerves to the scaleni and levatores costarum are cut. When the vagus is

cut respiration becomes slow, but does not stop. If the end in connection with the medulla is stimulated by an electric current respiration quickens again. The ends of the vagus in the air-vesicles are stimulated by their distension and collapse. The vagus therefore carries **impressions** to the centre. Other nerves may do the same, as the effect of cold water suddenly thrown upon the skin is to produce a sudden inspiration or gasp, due to the nerves of the skin carrying an impression to the medulla.

106. **Modifications of the respiratory movements.**

1. In **coughing** a deep inspiration with closure of the glottis is followed by a sudden expiration, which forces open the glottis and produces an explosive sound.
2. In **sneezing** there is a sudden expiration with closure of the mouth, the glottis remaining open. It is produced by stimulation of the nerves of the nasal cavities, and in some persons by looking at the sun.
3. **Laughing** consists of short expiratory blasts through the glottis, the vocal cords being tightened and the mouth usually open.
4. **Hiccough** is a sudden contraction of the diaphragm, which causes a momentary inspiration of air. This is however stopped by the closure of the glottis, and the vocal cords being rendered tight the well-known sound is produced.

CHAPTER IX.

FOODS: THEIR DIGESTION AND ABSORPTION.

107. Chapter II. may be conveniently re-perused before reading this article. Foods are divided into proteids, fats, amyloids or carbohydrates, and mineral substances. The flesh of animals consists of proteid, fat and mineral substances. **Roast meat** contains about 30 per cent. of its weight of proteids and 7 per cent. of fat. **Milk** contains all the food-stuffs in the proportions suitable to the needs of the infant. It has hence been called a **model** food. **Milk** contains about 4 per cent. proteid in the form of casein, 3 per cent. of fats (butter), 4 per cent. sugar (milk sugar), and about ½ per cent. mineral salts, which are sodium chloride, phosphates of potassium and calcium. **Butter** consists of about 90 per cent. fat; salt is added to facilitate its keeping and to impart a flavour. **Cheese** contains the casein and fat of milk. **Eggs** contain 14 per cent. of proteid (egg albumen), and about 10 per cent. of fat, but no sugar. **Bread** consists of about 10 per cent. of vegetable proteid (gluten), 50 per cent. of amyloid, 1 per cent. of fat, and 2 per cent. salts. **Potatoes** contain about 20 per cent. carbohydrates. **Bacon** contains 80 per cent. fat and 10 per cent. proteid. **Rice** contains 90 per cent. carbohydrate, and about 9 per cent. proteid. The following summary may be useful:—

FOOD-STUFFS	Proteids ...	Animal	1. **Albumin** of Eggs.
			2. **Myosin** of Muscle.
			3. **Casein** of Cheese.
		Vegetable	4. **Gluten** of Flour.
			5. **Legumin** of Beans.
	Fats	Animal	1. **Fat** of Butter, Meat, &c.
		Vegetable	2. **Oils** of Fruits, &c.
	Carbohydrates	Animal	1. **Glycogen** of Liver, &c.
		Vegetable	2. **Starch** of Flour, Rice, &c.
	Mineral Salts	**Common Salt, Lime, Phosphate of Lime, &c.**	

108. **Diet.** Professor Ranke in 1867 made experiments on himself. He used meat, bread, potatoes and fat, and found that with a daily diet of—

(1) Proteids	=	$3\frac{1}{2}$ ozs.	(100 grammes)
(2) Fats	=	$3\frac{1}{2}$,,	(100 ,,)
(3) Amyloids or Carbohydrates	=	9 ,,	(250 ,,)

he neither gained nor lost weight. In other words, the diet was **adequate.** The food-stuffs were calculated dry—that is free from water.

Other physiologists have given somewhat higher values for strong men working moderately hard. Pettenkofer of Munich would give daily—proteids, 5 ounces; fat, about $3\frac{1}{2}$ ounces; and carbohydrates, 13 ounces. These might be distributed as follows (calculated from paragraph 107):—

		Proteid.	Fat.	Carbohydrates.
Roast Meat,	8 ounces	2·4	·6	—
Bread,	18 ,,	1·8	—	9
Potatoes,	6 ,,	—	—	1·2
Rice,	4 ,,	·4	—	3·6
Butter,	2 ,,	·2	1·8	—
Bacon,	$1\frac{1}{2}$,,	·1	1·2	—
		4·9	3·6	12·8

The proteids may be increased in the case of powerful and muscular men, as navvies, or in cases where an excessive amount of work is performed.

109. **The Necessity and Economy of a Mixed Diet.**—(*a*) The **effect of a diminution or deprivation of proteids** in the food is to diminish the urea excreted in the urine. When the supply is totally stopped, after a few days less than half the usual quantity is excreted; but since the formation of urea **does** continue, and must come from the protoplasm of the tissues, the body becomes poorer in flesh, and gradually loses in vigour until the animal dies.

(*b*) **Effect of a Deprivation of Fat and Carbohydrates.**—It is possible for a man to live for a time on flesh alone, which is free from fat. But a healthy individual loses daily a quantity of carbon equal to 4,200 grains (9 ounces), and to obtain this, since roast meat contains only 16 per cent. carbon, he must eat about $5\frac{1}{2}$ lbs. of meat. This quantity of meat, however, contains nearly 2 lbs. of proteid, or more than 2,000 grains of nitrogen. But the body needs only about 250 grains of nitrogen daily. Such a quantity of meat, moreover, the digestive organs will not tolerate, so that the man is compelled to eat less; and then he obtains too little carbon from the food. To make up the **deficit** of carbon he must obtain it from his own substance. It is only in carnivorous animals, where the digestive organs are suitable, that a **purely flesh diet** is possible, and in this case the animal may lay on fat. It has been shown, indeed, that a proteid substance may split up into two portions within the body, one of which is eliminated from the body as urea, and the other may remain and become stored up as fat.

(*c*) By supplying a **lesser** quantity of **proteid** than an animal usually obtains, and replacing the deficit by means of fats and carbohydrates, a **fattening diet** is produced. Since fat, as a rule, in quantities more than 4 ounces daily is not well borne, the carbohydrates must be increased. On the other hand, in order to lessen corpulence, an abundant supply of proteid must be given, and care taken that fat, and especially carbohydrates (bread, potatoes, sugar), are prohibited, except in small quantities; also that an adequate amount of exercise is taken.

110. The advocates of Vegetarianism assert truly that plants contain all the three essential food-stuffs, that is, proteids as the gluten of flour, fats in the various oils, and starch. But vegetable proteids are not so nutritive as those of flesh, since not more than one **half** is utilised in the intestines, and the remainder leads to disturbances of digestion and disinclination

for food. It has been boastingly maintained that beans, which contain 23 per cent. of a vegetable proteid termed **legumin,** are as valuable as meat. But the percentage of this proteid assimilated is very low, and when combined with bacon, as is usual, in the case of a mixed diet, beans form an article of food which can only be tolerated by individuals with the most vigorous digestive powers.

111. **Water and Salts as Food.**—When water is completely withheld from animals, that is, including also the water which is usually contained in solid foods, the animals soon refuse to take anything at all, so that it amounts to complete starvation. The presence of mineral salts, especially sodium chloride, is quite as essential as that of water itself. When animals receive no mineral substances with the food, they suffer, after the lapse of a few weeks, from weakness and paralysis, and finally succumb.

112. The **mouth** forms the commencement of the **alimentary** or **food canal.** By means of its roof, called the **palate,** it is separated from the cavity of the nose. Behind, the palate is soft, and hangs down into the cavity of the pharynx like a

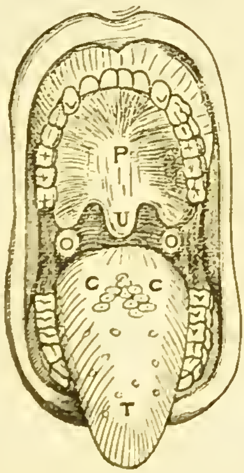

Fig. 71. The Mouth widely open: P, palate; U, uvula; O, O, tonsils; T, tongue; C, circumvallate papillæ.

curtain. This portion is called the **soft palate**. When the mouth is widely opened a slight projection called the **uvula** is seen to hang down from its edge (fig. 71). Posteriorly, therefore, the mouth enters the pharynx, and into the latter the nasal cavities also open by the posterior nares (see fig. 72). The floor of the mouth is formed by the tongue, which

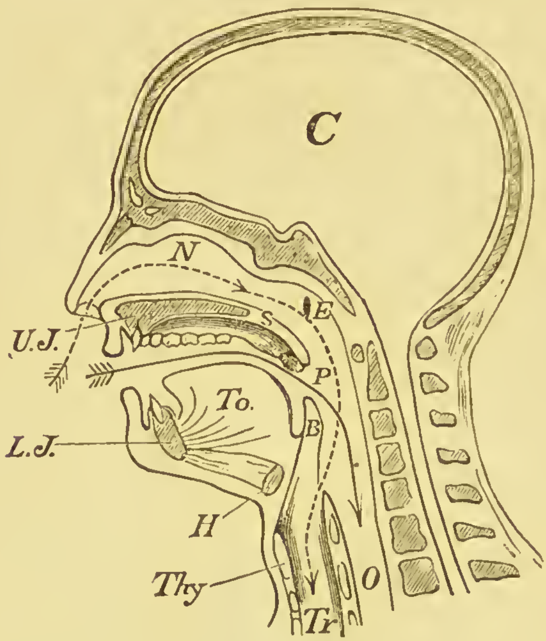

Fig. 72. Section of Face and Neck. The dotted line with arrows shows the direction along which air passes ; the continuous line with arrow indicates the food-tract. Letters as in fig. 63. The *proper* channel for the passage of air is always through the nose.

is a muscular organ, connected by muscular fibres to the lower jaw and to the **hyoid** bone, which can be felt between the chin and neck. The tongue contains upon its surface small papillæ or projections of three kinds. These papillæ are of great importance, since they are the **organs of taste**. Behind the tongue and connected with it is a piece of cartilage,

which, since it lies immediately over the **glottis**—the opening of the larynx and trachea—is called the **epiglottis**.

113. The **teeth** lie in cavities found in the upper and lower jaws. When complete they are 32 in number, 16 in each jaw and 8 on each side of the middle line. They vary in shape and size, and are classified into **incisors** or cutting teeth,

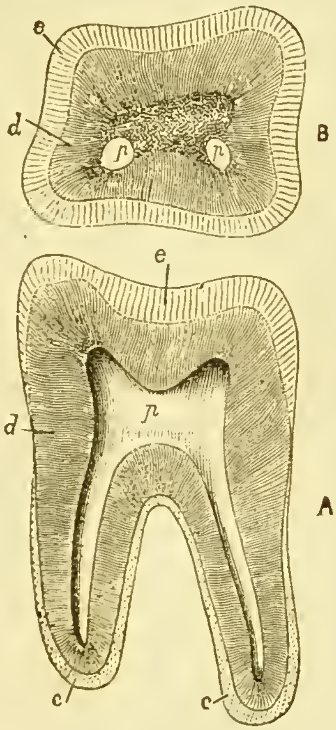

Fig. 73. The lower figure represents a Longitudinal Section of one of the Molar Teeth: *c*, crusta petrosa, or cement of the fangs; *e*, enamel; *d*, dentine; *p*, pulp cavity. The nerves and blood-vessels enter at the bottom of each fang and pass to the pulp cavity. B represents a transverse section of a tooth.

canine teeth, **bicuspids**, and **molars**. Each tooth consists of three parts (fig. 73)—a **crown**, which is visible, since it projects into the mouth; a **neck**, which is enclosed in the gums; and the **fang**, which is fixed in the bone of the jaw.

The crown is covered with **enamel**, a very hard substance; the fang or root is covered with **cement**, which resembles bone, and connects the fang to the bone of the jaws. The rest of the tooth consists of **dentine**. In the interior of the dentine is a cavity containing the blood-vessels and nerves (*p*, fig. 73).

The **incisor** teeth (fig. 74) are 8 in number, two above and below and on each side. These have broad cutting edges.

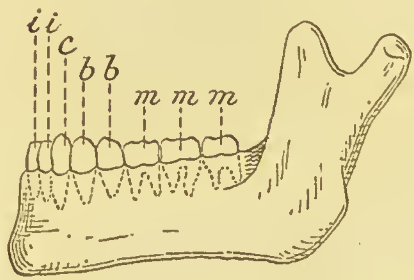

Fig. 74. The Lower Jaw and its Teeth: *i*, *i*, incisors; *c*, canine; *b*, *b*, bicuspid; *m*, *m*, *m*, molar teeth.

The **canines** are 4 in number, with pointed crowns. The **bicuspid** teeth are 8 in number; their crowns possess two cusps or ridges, separated by a hollow. The **molars** are 12 in number, possess several elevations on the surface of the crowns, and are well adapted for the crushing and grinding of food. The last molars are termed the wisdom teeth; these do not appear until the eighteenth year.

114. At birth the infant has no teeth. The two middle incisors of the lower jaw usually appear first, and about the sixth month. At about the age of three years the **first dentition** is complete, and consists of 20 teeth, namely, 8 incisors, 4 canines, and 8 grinders. These constitute the temporary or **milk** teeth, which are replaced by the dentition described in the previous paragraph. The change commences about the sixth year.

115. **The Salivary Glands.**—At the time the teeth are

masticating the food a flow of saliva is poured out by the salivary glands. This is due to a nervous influence (see paragraph 118). There are three pairs of salivary glands—**parotid, submaxillary,** and **sublingual.**

Each parotid gland lies just in front of the ear, and its duct opens into the mouth on the inner side of the cheek, close to the second upper molar tooth. The **submaxillary** glands lie beneath the lower jaw, and their ducts open into the floor of the mouth just beneath the tip of the tongue. The **sublingual** glands are the smallest, and can be felt as a slight ridge deep down between the tongue and the lower jaw.

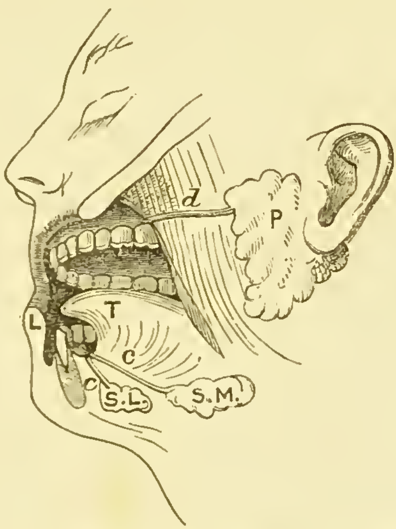

Fig. 75. A Diagram of the Salivary Glands: P, parotid gland; *d*, its duct; S.M., submaxillary gland; S.L., sublingual; *c*, *c*, their ducts; T, tongue; L, lower lip.

Their ducts also open into the mouth (fig. 75). When the ducts are followed into the gland they are found to divide and subdivide, and finally end in convoluted wavy tubes (*a*, *a*, *a*, fig. 76), or may sometimes end in small dilatations; the whole termination then resembles a bunch of grapes, and is called racemose. In these terminations, or **alveoli,** as they are

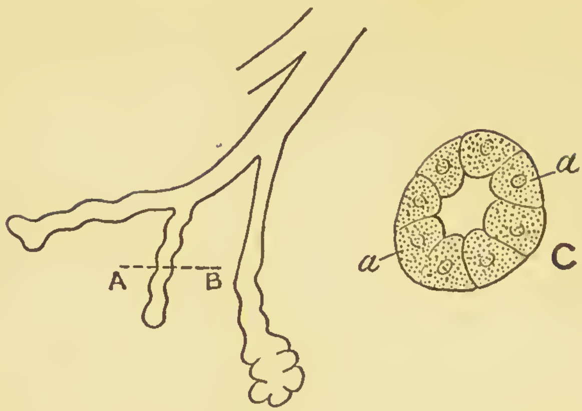

Fig. 76. Ending of one of the Tubes of the Salivary Glands: C, magnified section taken across A B to show the cells, *a*, *a*.

termed, the **true secreting** cells are found. These are granular, cubical, or spherical in shape, and according to the condition of the gland, that is, whether it has been at rest for some time or in activity, the number of granules is large or small. It seems, therefore, that the granules contain something which passes into the saliva.

116. The **saliva** is a watery, slightly viscid and alkaline fluid, which contains sodium chloride, carbonate of lime, a substance termed **ptyalin** (pronounced as if written tī′-ălin), and mucus. The substance ptyalin is the most important constituent of the saliva, since it has the power of converting the starch of the food into sugar. It has no action on proteids or fats. When the saliva is previously boiled, and then added to a solution of starch (made by adding hot water to starch and allowing to cool), there is no action, since the **ptyalin** has been **destroyed.** Moreover, a small amount of ptyalin will convert any quantity whatever of starch into sugar, provided the sugar is removed as it is formed. Such substances are called **ferments.**

117. When a solution of iodine (made by adding a solution of potassium iodide to iodine) is added to a solution of starch a **blue** colour is at once produced. When saliva is added

to another portion of the starch solution, and kept for half-an-hour in a moderately warm place, and iodine then added, no coloration is produced, or perhaps only a reddish colour, indicating the presence of dextrin. As soon as the reddish colour disappears, the starch has been mainly changed into sugar. The process of conversion of starch into sugar, which begins in the mouth, is carried on in the stomach for about half-an-hour, when the secretion of the stomach itself has become too acid and stops it, since ptyalin is powerless in the presence of acids. A solution of starch cannot be absorbed by the walls of the stomach into the blood, whereas sugar readily passes through.

118. Each salivary gland receives nerve branches from a cranial nerve, and from the sympathetic nerve. Thus the facial gives off a branch to the submaxillary gland, called the **chorda tympani**, and the **glossopharyngeal** a branch to the parotid gland. When these nerves are stimulated by the electric current, a secretion of saliva follows, and the arteries dilate. When a secretion of saliva occurs as a result of tasting food, a nervous impression is carried up from the sensory

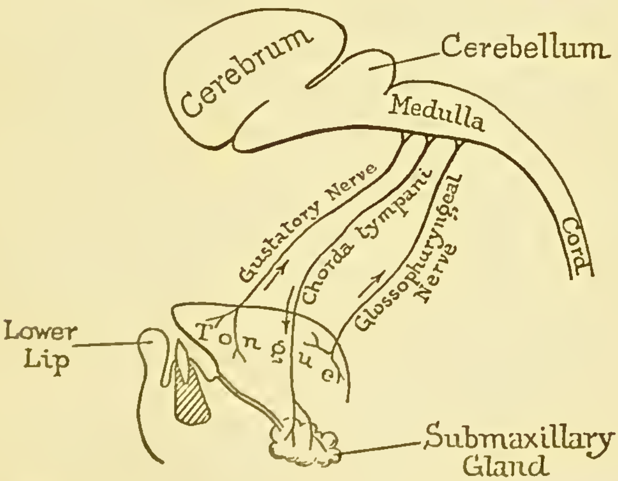

Fig. 77. Diagram of the Nerves of Taste and of the Chorda Tympani Nerve.

nerves of the tongue—the gustatory branch of the fifth cranial nerve and the glossopharyngeal—to the medulla oblongata, from which impulses are carried down again by the chorda tympani to the submaxillary gland and produce a secretion (see diagram, fig. 77).

119. **Deglutition**, or swallowing.—When the food is sufficiently masticated by the teeth, and mixed with saliva by the movements of the cheeks and tongue, it is collected on the tongue and thrust backwards into the pharynx. In order to prevent its passing into the nose by the posterior nares, the soft palate is drawn up by muscular action, and at the same moment, if the finger be placed upon the prominence which exists in the middle line of the neck called Adam's apple—it is really the thyroid cartilage of the larynx—the latter is felt to be suddenly raised. As a result of this movement the epiglottis falls over the glottis, and thus shuts off the respiratory passages. In cases of injury to the epiglottis, fluids often go the "wrong way," that is, gain entrance into the respiratory passages and set up a fit of coughing. The only way left for the morsel is into the œsophagus. It is carried slowly down by the movements of the walls of the œsophagus into the stomach. With the exception of the first part, that is, the thrusting of the food backwards, swallowing is entirely a **reflex** act, and can be performed when a person is in a state of unconsciousness.

120. The **stomach** lies on the left side, in the abdomen, just beneath the diaphragm. It is a dilated part of the alimentary canal. Its left or **cardiac** end receives the œsophagus, while the right end, or **pylorus**, opens into the duodenum (fig. 78). Its upper border is termed the lesser, and the lower the greater, **curvature**.

Like the rest of the alimentary canal it consists of a mucous coat, of a muscular coat, and of a fine tissue, called submucous coat, which unites the two coats. The mucous membrane lines the interior, and is provided with an epithelium.

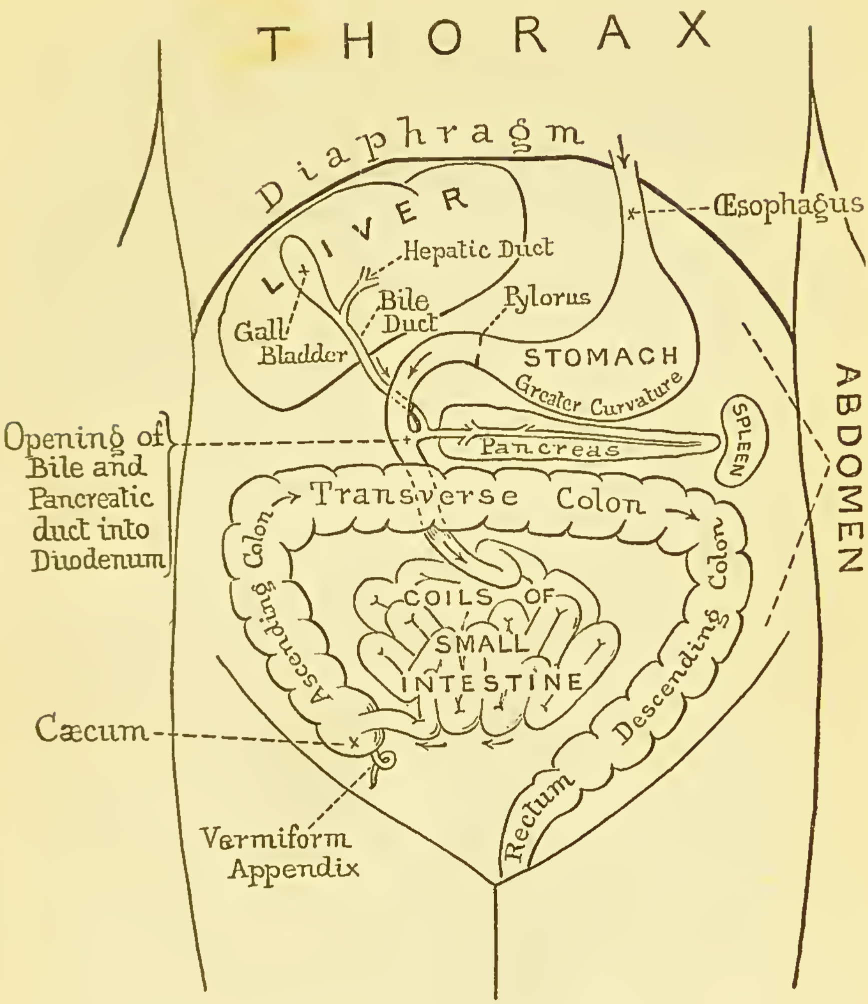

Fig. 78. Diagram of the Alimentary Canal in the Abdomen.

In the stomach the epithelium consists of one layer of columnar cells. It is usual for the alimentary canal to possess **two** layers of **unstriped** muscle, the outer of which runs **longitudinally**, and the inner **circularly**. In the stomach there is also an inner **oblique** layer of unstriped muscle, and at the pylorus its circular layer is very strong and forms a **sphincter**, that is, it keeps the orifice into the duodenum closed. In the

same way there is a sphincter where the œsophagus ends in the stomach. The stomach, like the intestines, also possesses an external coat, formed by the peritoneum. This is termed its **serous** coat.

121. **The Glands of the Mucous Membrane.**—The mucous membrane of the stomach, when washed and examined with a lens, is seen to be covered with minute depressions. Into these depressions open very minute and microscopic tubes called the **gastric glands**. When a fine section of the stomach is made, after it has been hardened, and stained by appropriate colouring reagents, as carmine or logwood, the whole mucous membrane is seen to be occupied by tubes, which run perpendicularly to the surface, and open upon it. These glands are of two kinds; those in the neighbourhood of the pylorus are branched and lined by columnar cells

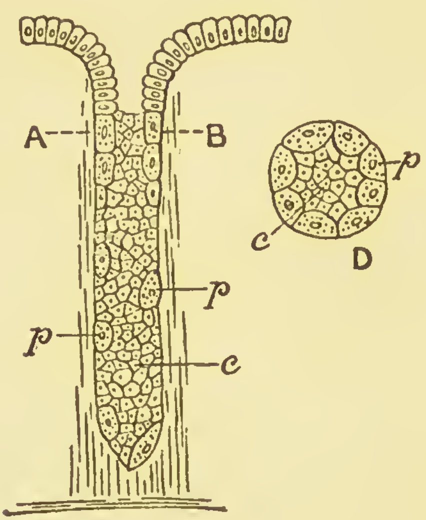

Fig. 79. A Peptic Gland, highly magnified: *p*, parietal; *c*, central cells; D, section across the mouth of the gland, that is, across line AB.

throughout; but those in the rest of the stomach contain two kinds of cells (fig. 79), those on the exterior of the tube are large, **oval**, and called **parietal cells**; the smaller in the

interior of the tube are **smaller**, and are the **central cells**. These glands secrete the gastric juice. The blood vessels are numerous; they form a network encircling the gastric tubes.

122. **Gastric Juice and its Composition.**—When food is introduced into the stomach, the mucous membrane, which was previously pale, becomes pink, indicating that there is a dilation of the blood-vessels, and consequently more blood passing through them. At the same time the gastric glands secrete a colourless fluid, with an **acid** reaction called the **gastric juice**. The juice contains two substances of great importance, namely, free **hydrochloric acid** (HCl), about 2 parts in every 1,000, and a substance called **pepsin**, about 4 parts in every 1,000. Besides, it contains traces of sodium chloride, the rest being water. At the same time that the glands are secreting, the walls of the stomach, by their contraction, are subjecting the food to certain movements whereby the food and gastric juice become intimately mixed. Thus the food moves along the greater curvature, reaches the pylorus, but

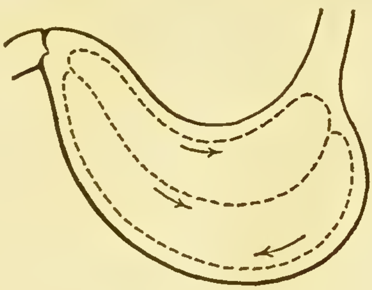

Fig. 80. A Figure showing direction of Movement of the Food within the Stomach.

cannot enter the duodenum as the sphincter is closed, and passes back along the lesser curvature (see fig. 80).

123. The action of gastric juice depends on its hydrochloric acid and pepsin. Pepsin is a **ferment** like ptyalin, but its action is almost entirely limited to proteids. On fats and starch it has no influence. Pepsin converts all proteids into

peptones. Now peptones do not coagulate when heated, and they pass readily through animal membranes, like the wall of the stomach. The **casein** of milk, the **myosin** of muscle, the **gluten** of bread, are all converted into the same substance—**peptone.** It is certain, however, that very soon the peptone is converted into the serum albumin of the blood, since blood contains no peptone. This reverse action is probably performed by the agency of the cells in the mucous membrane, and the object of conversion of all the various proteids into peptone may be to ensure a uniform composition of the blood; in other words, that the proteid of the blood should always be serum-albumin. As the action of the gastric juice proceeds the contents become more liquid, and the sphincter relaxes, so as to permit the contents to pass into the intestine. As it passes out the fluid is termed **chyme**. Thus after an ordinary meal, consisting of meat containing fat, potatoes, bread and pudding, the chyme on leaving the stomach will contain—

(1) Saliva, sugar, and some unconverted starch.

(2) Gastric juice, peptone (some of which escapes absorption), and some of the gluten of the bread and the myosin of the flesh which have escaped peptonisation.

(3) Fat, which will have undergone little change, except the covering of the fat cells, which consists of protoplasm, will have been dissolved.

(4) Mucus secreted by the columnar cells of the stomach.

124. A certain amount of absorption has taken place. Some of the peptone and sugar have passed into the gastric veins, which carry them to the liver. Dr. Beaumont in 1838 observed the process of digestion in the stomach of a Canadian who had a gun-shot wound, which placed the cavity of his stomach in communication with the exterior. The duration of the process of digestion in the stomach was about 4 hours. The time required to digest lamb is about $2\frac{1}{2}$ hours; beef and mutton require rather longer.

125. The **intestine** (fig. 78) is divided into **large** and **small** intestine. These differ in important particulars. In the **large** intestine the longitudinal **external** layer of muscular fibres is not complete, but runs in three bands. Also the mucous membrane of the small intestines possess numerous small projections called **villi**. The mucous membrane of **both** small and large intestines contains minute tubular glands, called **Lieberkühn's** glands from the anatomist who first described them. Moreover, the small intestine **alone** possesses a number of transverse folds called **valvulæ conniventes**.

126. The **small** intestine is divided into three parts—**duodenum, jejunum** and **ileum,** of which the last joins the large intestine. The **duodenum** is about 10 inches long, and into it open the ducts of the pancreas and liver. It possesses glands called the **glands of Brunner,** in addition to the glands of Lieberkühn. If we make a thin section of

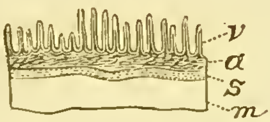

Fig. 81. Wall of Ileum of Cat, three times enlarged: *v*, villi; *a*, mucous membrane; *s*, submucous coat; *m*, muscular wall.

the ileum we can recognise the mucous membrane, with its villi, and the muscular layers with the naked eye (fig. 81). Each villus contains a lymphatic vessel and blood-vessels, the remainder is filled up with lymphoid tissue. The lymphatic lies in the centre, and the blood-vessels just beneath the epithelium which covers the villus (fig. 82). In some parts of the mucous membrane of the intestine the lymphoid tissue is collected into masses about as large as the heads of small pins; and in the **ileum** these masses are collected into patches sometimes an inch in length, called **Peyer's patches.**

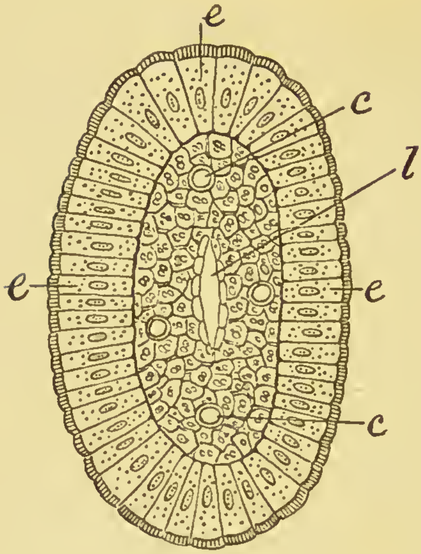

Fig. 82. Diagram of the Transverse Section of a Villus, very highly magnified : *e*, *e*, *e*, columnar cells; *c*, *c*, blood capillaries; *l*, lacteal. The tissue between cells *e*, *e* and the lacteal is lymphoid. (Page 50.)

127. The **large** intestine consists of the cæcum with vermiform appendix, colon and rectum. The cæcum is short in man, in the sheep and rabbit, however, it is an enormous tube. At the entrance of the ileum there is a valve, the **ileo-cæcal** valve, which permits the contents of the small

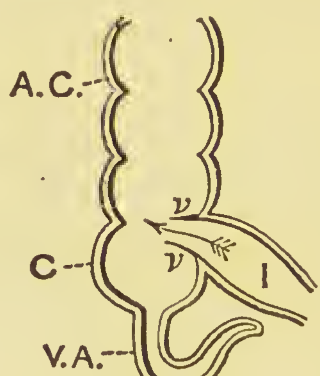

Fig. 83. The Ileo-cæcal Valve : I., ileum ; C, cæcum ; V.A., vermiform appendix ; *v*, *v*, edges of valve ; A.C., ascending colon.

intestine readily to pass into the large intestine, but opposes their return (fig. 83).

128. The **pancreas** lies behind the stomach, and its duct joins that of the liver before entering the duodenum. It is a gland with a structure very similar to the salivary glands, and like the latter, it secretes a fluid called the **pancreatic juice**. This juice is alkaline, and contains sodium carbonate and three ferments, (*a*) **trypsin**, which converts proteids into peptones, like the gastric juice, so that any proteid which has escaped the gastric juice is now attacked by the pancreatic. (*b*) A ferment similar to the ptyalin of the saliva, which converts starch into sugar. (*c*) A third ferment which acts on fats and forms an **emulsion**.

If a quantity of **olive oil** be shaken up with pancreatic juice, the oil at once begins to resemble milk, becoming perfectly white, because the globules of oil are now in a very fine state of division. A little carbonate of soda may be substituted for the pancreatic juice. After vigorous agitation of the oil and carbonate of soda the mixture becomes quite white, as before. The very fine globules of the fat are then, in the intestine, absorbed by the **columnar cells of the villus**, and pass on to the **lacteals**. If a dog be killed during digestion, and the mesentery examined (that is, the fine membrane consisting of peritoneum, which attaches the small intestine to the back of the abdomen), very fine vessels are observed, which are perfectly white. These are the lacteals or lymphatics of the mesentery filled with fat. The liquid is now termed **chyle**.

129. In the small intestine, therefore, the food is still further changed. The proteids are converted into peptone, which passes through the intestinal wall, and enters the veins. The fats are changed physically, so that now they are in a very fine state of division, and enter the villi and pass to the lacteals. The starch of the food which has escaped conversion into

sugar now suffers that change, and is absorbed into the veins and carried to the liver.

130. By the movement of the walls of the small intestine, called **peristalsis**, the contents are carried into the large intestine. This movement or peristalsis is seen when an animal is killed and the abdomen immediately opened. In the **large** intestine the contents become more solid, since water is absorbed from them. The portions of the food which are insoluble and indigestible collect in the rectum before expulsion.

131. The **liver** lies in the abdomen, immediately under the diaphragm on the right side, and extending across the middle line, covers the duodenum and stomach in part. In the adult it weighs about 50 ounces. When the liver is turned upwards, so that the under surface is visible, the **gall-bladder** and its ducts are to be seen, and a groove which lies transversely, called the transverse fissure, through which the vessels pass into its interior. From the same fissure issues a small duct, called the **hepatic duct**, which soon joins the duct from the gall-bladder. From the junction of these two ducts, the common bile duct passes to the duodenum.

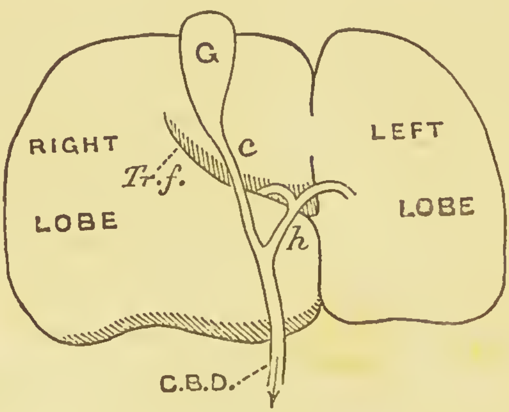

Fig. 84. The Under Surface of the Liver: G, gall-bladder; *c*, duct from gall-bladder; *h*, hepatic duct from liver; C.B.D., common bile duct passing towards duodenum.

132. The liver is a solid, dark, red organ. When cut into, the vessels are observed branching through it, and with the naked eye we notice that its substance is divided into small areas, about the size of a pin's head, called **lobules.** When magnified with the microscope, in a thin section, the lobules

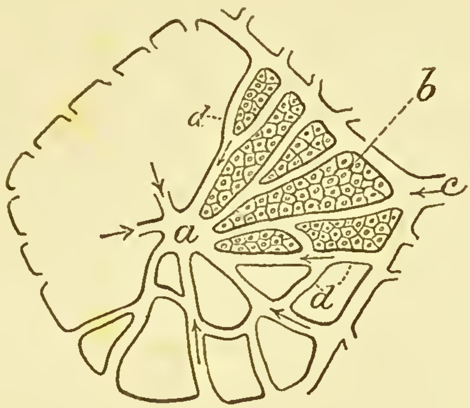

Fig. 85. Diagram of a Lobule of the Liver, highly magnified: *b*, liver cells; *c*, ending of portal vein in capillaries, *d*, *d*; *a*, central vein of the lobule, which joins with those of other lobules to form one of the hepatic veins.

are seen to be composed of cells, about $\frac{1}{1000}$ of an inch in diameter (fig. 85). These liver cells are somewhat irregular in shape, contain a nucleus, and granules, consisting of fat and glycogen. In order to see the arrangement of the vessels and capillaries, these must be filled immediately after death with some colored substance. A small tube is placed in the portal vein, and a fluid consisting of Prussian blue and gelatin is allowed to flow through the liver under pressure. The fluid must be kept warm, since on cooling, the gelatin becomes solid. Before the injection is finished, the inferior vena cava in the thorax should be tied. The liver is placed in alcohol for a few weeks, and thin sections cut with the razor. The capillaries are stained blue. Similarly, when a tube is placed in the hepatic duct, and a coloured fluid is sent in, the fine commencements of the duct, in very minute vessels, are seen.

133. **Circulation in the Liver.** The portal vein having collected the venous blood from the stomach and intestines (see fig. 39), enters the liver, dividing and subdividing just like an artery, and at length ends in fine capillaries which pass into the interior of each lobule (fig. 85). They run forwards to its centre, where they unite to form a small vein. These veins finally unite to form the three hepatic veins, which carry away the blood of the liver to the inferior vena cava. The liver is also supplied with arterial blood by the hepatic artery, which is a branch of the aorta in the abdomen (fig. 13). It supplies the walls of the branches of the portal vein and bile duct. The bile ducts commence as very minute spaces between the liver cells themselves.

134. The passage of blood from the portal vein through the liver into the inferior vena cava, depends on the difference of pressure of the blood in the two veins. Since the pressure in the inferior vena cava is very little less than that in the portal, it follows that the stream through the liver must be very languid and sluggish. The bile, secreted by the liver cells, reaches the hepatic duct, and if secreted in excess, is temporarily stored in the gall-bladder. The formation of bile is directly dependent on the portal stream of blood, since when the latter vein is tied the flow of bile ceases.

135. **Bile** is a yellow alkaline fluid which contains about 9 per cent. of what are termed the **bile-salts,** and 3 per cent. of bile **pigment** and mucus, with traces of fat and salts. Bile owes its properties to its bile-salts. These are sodium salts of acids called **glycocholic** and **taurocholic.** In the intestines these are partially decomposed into **glycin, taurin,** and **cholic acid,** but a certain proportion passes through the walls of the intestine as bile-salts to be resecreted. The bile-salts aid in the emulsification of fat, and therefore in its absorption.

136. In man the **bile** has a yellowish-orange colour. The colour is due to a pigment called **bilirubin.** This pigment is

somewhat similar to the hæmoglobin of the red corpuscles, and is derived from it by the agency of the liver cells. When the common bile duct is inflamed, as an effect of cold to the system, the bile is hindered from passing into the intestine, the bile pigment passes into the blood, and stains the skin and the white of the eye of a yellowish tinge (jaundice).

137. **The Glycogen of the Liver.**—If a rabbit be killed and the liver immediately removed, cut into small pieces, thrown into boiling water and boiled for twenty minutes, afterwards alcohol (spirits of wine) added, a white substance falls down, which is **glycogen.** The rabbit should have been previously well fed, best on carrots, and killed while digestion is proceeding. The glycogen may be separated by passing the fluid through filtering paper. It is readily soluble in water and insoluble in alcohol. It belongs to the carbohydrate family, and therefore contains no nitrogen. Its formula is $C_6 H_{10} O_5$. When a solution of iodine is added a red colour is produced. It was first prepared by the French physiologist, Claude Bernard, in 1856.

138. **Influence of Food** on the quantity of Glycogen.—When much carbohydrate food is taken the quantity of glycogen increases. Proteids produce a little, while fats have no influence whatever. It seems that the liver-cells can seize upon the sugar of the blood passing through the liver and convert it into glycogen. In starvation the glycogen disappears from the liver altogether, and it disappears after death, since the cells of the liver convert it into sugar. The boiling water destroys the cells. It has been thought, therefore, that the liver stores up glycogen as a kind of **reserve food,** which is then little by little converted back into sugar when the animal starves, or when carbohydrates are not present in its food.

139. The liver has also the power of converting **proteids** into sugar. When dogs are fed on peptone only, the quantity of sugar in the **hepatic** vein still remains **twice** that in the **portal** vein. Also the urea excreted by the kidneys is

increased by feeding on peptone. It seems that in the liver proteids may be split up into two portions, one containing all the nitrogen, which leaves the body as urea, and the other which may be converted into sugar. The sugar, in passing round the body, is used up in the muscles and other organs, forming a source of energy as well as helping to preserve the temperature of the body.

140. **Relation of Food to Work.**—The German chemist, **Liebig,** thought all proteids were used to replenish the **protoplasm** of the tissues; and non-nitrogenous foods—fats and carbohydrates—were converted into carbonic acid and water, producing heat, and thus keeping the body warm. He imagined, therefore, that when a muscle was put into action a certain proportion of its substance became dead, used up as it were, and passed eventually as urea out of the body. But it is known that a Hindoo labourer, for instance, receives but little proteid in his food. He will subsist comfortably if he is provided daily with a pound of rice, a little butter and fish. Moreover, it has been proved that exercise has little influence on the quantity of urea excreted; but the carbonic acid and water exhaled by the lungs are enormously increased. Dr. Flint, of New York, made experiments on the pedestrian Weston, and found but a slight increase of urea. The muscles are therefore comparable to a machine, and a small amount of wear and tear of their own substance, especially during excessive exercise, may be admitted, and may account for the slight increase of the quantity of urea.

141. **Absorption.**—We have already said that a certain proportion of the plasma and white corpuscles may pass through the delicate walls of the capillaries into the surrounding tissues. This fluid nourishes the tissues, receives the products of their own activity, and is called **lymph.** It exists in the spaces of the connective tissue, and passes into very fine lymph capillaries or **lymphatics.** These unite into larger vessels, which carry the lymph eventually into a duct which

lies in the chest and abdomen, close to the vertebral column, called the **thoracic duct.** The latter opens into the left internal jugular vein, just above the level of the clavicle (fig. 37). Along the course of the lymphatics small enlargements are met with, called the **lymphatic glands.** These lymphatic glands are masses of **lymphoid** tissue, that is, they contain lymph cells in abundance. As the lymph streams through, some of the cells are washed into it. When the cells reach the blood they are termed **white corpuscles.** The lymphatic glands, therefore, must perform a very important function. The lymphatics of the intestines, which lie in the mesentery, are called lacteals, and during digestion they contain **chyle.**

142. The **lymph** is an alkaline fluid which coagulates like the blood, and contains a few lymph cells, but no red corpuscles. It consists of about 5 per cent. solids, the rest being water. The solids in solution are albumin, with traces of urea and sodium chloride.

143. **Chyle** may be collected from the horse or cow by tying a small tube in the thoracic duct. It is a white milky fluid containing a few lymph cells, and a multitude of minute fat globules. It contains about 8 per cent. of solids; of these albumin about 3, fat 5, and traces of urea and sodium chloride. The lymph and chyle pass along the lymphatics by virtue of the fact that the latter, as well as the thoracic duct, are richly provided with valves, which only permit the fluid to pass towards the neck. Also the pressure, which in the thorax becomes **negative** during inspiration, must aid in the flow. A small valve is placed at the junction of the thoracic duct with the left internal jugular vein, which prevents blood from passing into the lymphatic system.

144. The **fat**, in a fine state of division, is taken up by the cells of the villi of the small intestine and passes into the lacteals. Of the peptone, some passes into the capillaries of the wall of the intestine (probably also a vital act on the part

of the epithelial cells), and thence passes by the portal vein to the liver. A portion of the peptone also enters the lacteals. In the course of the passage the peptone is reconverted into albumin. Sugar mainly passes into the blood capillaries and thence to the liver. The proof that peptone must be changed lies in the fact that none is to be found in the portal vein or in the thoracic duct.

145. **Formation and Fate of the blood corpuscles.** The white blood corpuscles are renewed by means of the **lymphoid** tissue of the lymphatic glands and mucous membranes. These lymph cells are washed out by the stream of lymph. The red blood corpuscles are produced in the **marrow** of bones. They are said to arise from peculiar nucleated cells of a reddish colour. The nucleus subsequently becomes either obscured or lost. Whether these peculiar cells originate from white blood cells is unknown.

The **spleen** contains a number of masses of **lymphoid** tissue, but there is an abundant supply of blood. In the substance of the spleen, red blood corpuscles have been found **broken up** and **altered.** It is therefore supposed that the old red corpuscles, which have become somewhat rigid and useless, are destroyed in the spleen, and the splenic vein carries their hæmoglobin to the liver, where the liver cells convert it into bile pigment.

CHAPTER X.

EXCRETION: THE SKIN AND KIDNEYS.

146. The skin consists of two parts—an outer, the **epidermis**; and an inner, the **dermis.** When a thin section of the skin, made at right angles to its surface, is examined under the microscope, the epidermis is seen to be made up of layers of closely packed cells, the deepest of which have a a columnar shape (fig. 86). As we approach the surface the

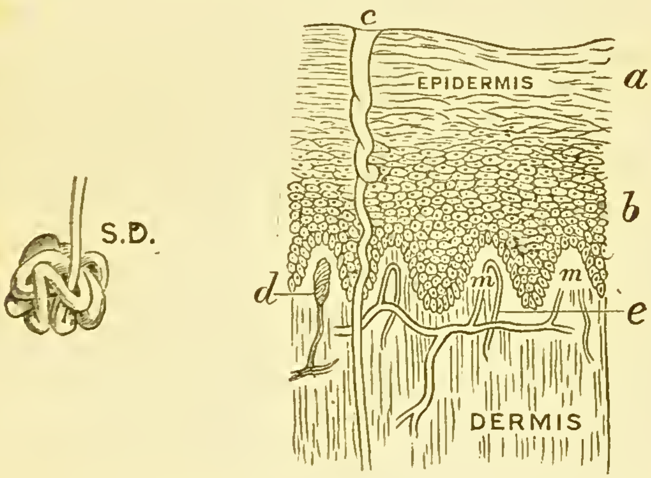

Fig. 86. Section of Skin, highly magnified: *a*, horny layers of epidermis; *b*, deeper layers of epidermis; *m*, papilla of the dermis; *e*, capillaries of these papillæ; *d*, a touch corpuscle with its nerve; *c*, duct of a sweat gland. In the small adjoining figure S.D. represents the coiled end of the sweat duct, which forms the sweat gland.

cells are observed to become flatter, and to acquire a horny character. In the negro the deepest layers contain much pigment.

147. The **dermis** or corium is composed of connective tissue with elastic fibres, and its surface is raised into **papillæ.** The dermis also contains adipose tissue, blood vessels and nerves. To each papilla a small blood-vessel is distributed, and some of them possess small bodies, about $\frac{1}{300}$th of an inch in length, called **touch corpuscles.** Still deeper in the dermis in some parts—especially in the palm and sole—oval bodies are met with, about $\frac{1}{12}$th of an inch long, therefore visible to the naked eye when removed from the skin They are called **Pacinian bodies,** from the Italian anatomist, Pacini, who first described them.

148. The skin also possesses two kinds of glands—**sweat glands** and **sebaceous** or oil-glands. The former are met with in all parts of the skin. Each consists of a minute tube with a **coiled end** in the dermis below. It opens on the surface, and the orifices of these glands may be seen on the ridges of the skin of the palm by means of a small pocket lens. Altogether the sweat glands number about three millions. The sebaceous glands open into the pits (or follicles), in which the roots of the hairs are imbedded. They secrete an oily material.

149. The **sweat** is usually said to be excreted by the sweat glands, though some authorities think it may exude from the capillaries contained in the papillæ of the dermis. The sweat contains traces of sodium chloride, carbonic acid and urea. About 20 ounces of water are excreted daily in the sweat.

150. The **appendages** of the skin are the **nails** and **hairs.** The nails are thickenings of the outer horny layers of the epidermis, and hence, like the epidermis, contain no vessels. The roots and edges of the nail are embedded in a fold of skin. Hairs consist of a **shaft** and **root,** the latter passing into a **follicle** or sac of the skin, and the walls of the follicle, consisting of epidermis and dermis, form the sheath of the root. The hair itself is purely epidermal in structure.

When traced to the bottom of its sac, it is found to end in an enlargement called a **papilla**. This papilla consists of epidermal cells, by the growth of which the shaft is lengthened. The roots of the hair are also provided with unstriped muscular fibres, which pass to the upper part of the dermis (fig. 87).

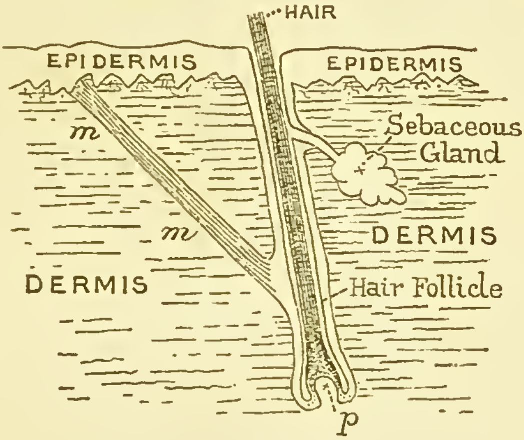

Fig. 87. Diagram of Skin with Hair: *m*, *m*, unstriped muscle of the hair; *p*, papilla of the hair.

When these contract, as under the influence of fright or cold, the hairs are pulled into a vertical position.

151. The **functions of the skin** consist (1) in regulating the temperature of the body, (2) in appreciating the sensations of touch, pressure, heat and cold, and (3) in the excretion of carbonic acid in the sweat. But this amount in man is small as compared with the CO_2 exhaled by the lungs, the latter excreting 200 times as much as the skin. In frogs the skin is of more importance as an organ of excretion, since after their lungs are removed oxygen is still absorbed and carbonic acid excreted.

152. The **kidneys** lie at the back part of the abdomen. Each weighs about four ounces. If the kidney of the sheep or rabbit be cut into two, lengthwise, the part nearer the

circumference is seen to be somewhat granular, and is called the cortex (fig. 88). The more internal part of the kidney

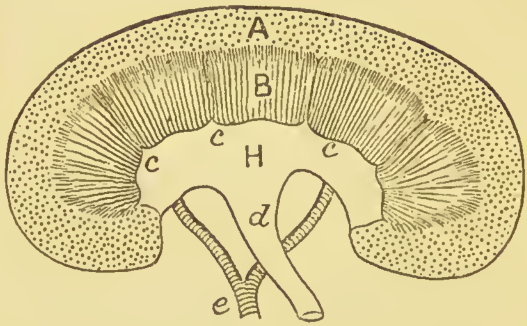

Fig. 88. Section of the Kidney of Sheep, half the natural size: A, cortex; B, medulla; *c*, *c*, *c*, ridge; *d*, ureter dilating at H; *e*, renal artery.

appears striped, and is termed the medulla. In man's kidney the medulla is split up radially into several parts by portions of the cortex passing between them. These separate parts are called the **pyramids.** The pyramids are seen to project into the hollow of the kidney, and to be received by the dilated part of the ureter, which conveys the urine to the bladder.

153. When a thin section of the kidney is examined, microscopically, the **Malpighian capsules** are visible, and are seen to form the commencements of minute tubes or **tubules,** as they are named. Each tubule is at first slightly convoluted (fig. 89), then follows a long portion which forms a loop, called the loop of Henle; then it is slightly convoluted again and ends in a straight tube. The straight tubes pass down the medulla, joining with each other as they proceed, and finally open, at the apex of the pyramid (*a*, fig. 89), into the dilated ureter. In the sheep, the medulla is somewhat indistinctly separated into 5 pyramids, and if the ridge *cc* be carefully examined, minute holes may be observed where the tubules open.

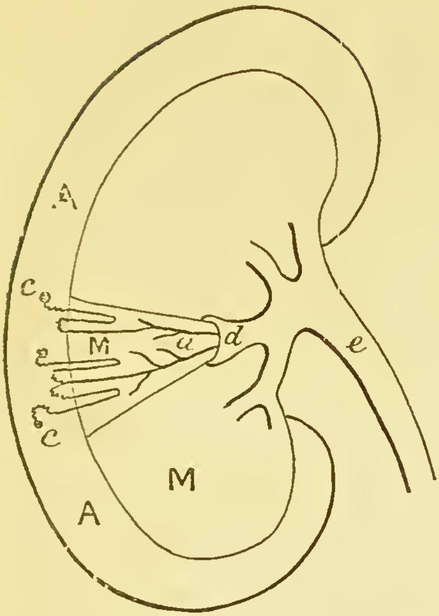

Fig. 89. Diagram of Human Kidney: A, cortex; M, medulla; *a*, apex of one of the pyramids, of which the medulla is composed; *c*, *c*, malpighian capsules; *d*, ending of the apex, *a*, of a pyramid in the dilated part of ureter; *e*, ureter. (Only one of the 12 or 13 pyramids is represented.)

154. The renal artery enters the kidney and divides into many branches. From some of these a small artery passes to the **Malpighian capsule** (fig. 90). Entering, it breaks up at once into capillaries, which again unite to form a vein

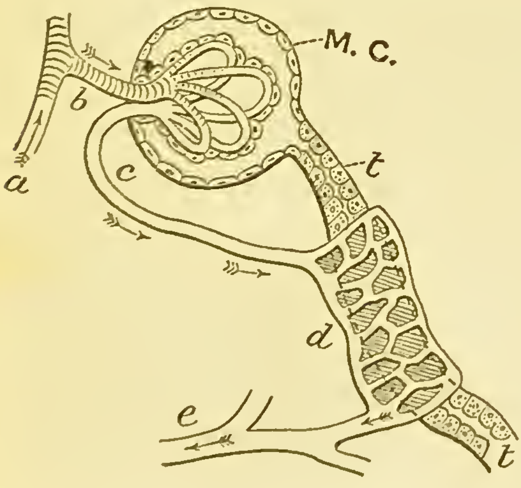

Fig. 90. Diagram of a Malpighian Capsule, M.C.: *a*, artery (a branch of the renal artery), which gives off a branch, *b*, to the capsule. This branch breaks up into capillaries, which are covered with cells. The blood leaves by the vein *c*, which breaks up again into capillaries, *d*, over the tubule, *t*, *t*; *e*, vein leaving capillaries of tubule.

which leaves the capsule and lies beside the artery. The capillaries, therefore, form a **tuft**, which dips into the capsule. They are covered by a layer of flattened cells, while the opposite wall of the capsule is lined by similar cells. The **tubule**, on the other hand, is lined by granular, cubical cells (fig. 90). When the vein leaves the capsule, it sweeps around and breaks up into **capillaries** over the tubule, which again are collected into **veins** which form tributaries of the renal vein. The kidney is supplied with arterial blood by the renal artery, which is a branch of the aorta in the abdomen. The renal vein enters the inferior vena cava.

155. The urine is a pale yellow fluid, with an acid reaction (due to the sodium phospate). It contains water, urea, and uric acid, and salts, chiefly sodium chloride, and potassium chloride, sulphate of sodium, and phosphate; also small quantities of oxygen and carbonic acid. About 50 ounces of urine are excreted daily, containing 500 grains of urea.

156. The following table exhibits the contrast between the composition of the plasma of the blood as it travels through the Malpighian tufts, and the urine.

PLASMA contains—	URINE contains—
1. Serum albumin and globulin.	1. No serum albumin; no globulin.
2. Fat.	2. No fat.
3. Trace of urea.	3. Large quantity of urea.
4. Trace of sugar.	4. No sugar.
5. Salts of sodium, &c.	5. Salts of sodium, &c.
6. Water.	6. Water.

There is evidently a radical difference. But the plasma in the Malpighian tufts (fig. 90) is only separated from the cavity of the tubule by, first the capillary wall, and secondly the layer of flat cells covering them. We know that the proteids of the blood will diffuse through the capillary wall itself, so it must be the additional layer of cells which prevent it in this case. It is readily seen that the process of separation of urine cannot be

a **mere filtration**, except perhaps in the case of the salts and the water.

157. The **secretion of urine** varies directly with the pressure of the blood in the capsules. Thus if the arteries of the limbs and neck of an animal are tied, the pressure in the other arteries is increased. The pressure in the renal arteries also becomes higher, and an increased flow of urine follows. When the renal vein is tied, the pressure in the capsule also must increase, but the flow of urine **ceases.** The essential circumstance for a rapid flow of urine seems then to be a **rapid** and full **flow of blood** through the **tufts** of Malpighi. Under ordinary circumstances the renal vein, of course, remains unobstructed, so that an increased pressure in the renal arteries usually leads to a more rapid stream through the capillaries of the Malpighian capsule and an increased flow of urine. In this way a contraction of the arteries of the skin, in cold weather, would lead to a larger excretion of urine.

158. **The flow** of the **watery** part of the urine is thus dependent on the pressure of the blood, and this is, perhaps, true also of the salts. But as regards the **urea** we know that the cells of the convoluted tubule possess a secretory power, (1) from the appearance of the cells themselves, and (2) by the fact that when a substance called **indigo-carmine** —which is blue when dissolved in water—is injected into the veins of a living animal, after death these cells are stained blue. It may be that the cells in the same way **pick out** urea from the blood as it is passing in a slow stream through the capillaries (*d*, fig. 90) into which the vein of the capsule breaks up. For when the kidney is removed from the body, urea accumulates in the blood, showing that the kidney does not manufacture it.

159. The kidney does not possess any special secreting nerves as do the salivary glands, but it possesses nerves which pass to its blood vessels, called **vaso-motor**, some of which, when stimulated, dilate the vessels (vaso-dilating) and increase

the pressure of blood, and therefore the flow of urine. Others act in the opposite direction (vaso-constricting). So it may be that, although the mere drinking of fluids does not necessarily increase the excretion of urine, still certain substances present, for instance, in beer or spirits may act by dilating the blood vessels, that is by stimulating the vaso-dilating nerves, or in some cases, stimulate the cells of the convoluted tubules themselves, since whenever they are excreting urea, at the same time **a current** of water is excreted in order to wash the urea into the tubule. About 150 grains of sodium chloride and 40 grains of sulphates are excreted daily.

160. The ureters carry the urine to the **bladder**, passing to its posterior and lower part and entering the walls of the bladder obliquely, so as to prevent reflux. The bladder is oval, and situated at the lower part of the abdominal cavity. Its walls contain unstriped muscular fibres, while at the orifice, where the bladder opens into the urethra there is a special circular muscle called the **sphincter**, by which the contents of the bladder are retained until they are voluntarily expelled.

Section II.

HYGIENE.

BY

ELIZABETH J. MOFFITT, B.Sc. (Lond.)

CHAPTER I.

FOOD.

We require to eat food for four reasons—

(1) To produce heat in our bodies.

(2) To enable us to do work.

(3) To renew the waste of the body, and so keep it from losing weight.

(4) During part of life to provide extra material, so that the body may gain in weight or grow.

It is found that all the substances used as foods may be classed under one of four heads. They are either **Proteids**, or **Fats**, or **Carbo-hydrates**, or **Minerals**. These four substances are called **food-stuffs** or **food-substances**. We will study each of them separately to find what share each takes in providing for the four wants of the body mentioned above. To begin with proteids.

Proteids.—These make up the principal part of lean of meat, white of egg, cheese, milk, peas and beans. They contain the chemical elements carbon, nitrogen, hydrogen, oxygen, with a little phosphorus and sulphur. By a chemical element we mean a substance which cannot by any means in our power be broken up into simpler substances. Sulphur, iron, and carbon are familiar instances of elements.

Chemists have found out that the human body is made up of these same elements together with some water and other mineral matters, and so, as we might expect, proteids are found to be especially useful in making good the waste of the body and also in enabling it to grow. They are therefore called tissue formers, or flesh formers, but it must not be forgotten that they produce heat and enable us to work as well.

Carbo-hydrates are found nearly pure in starch and sugar, and make up part of bread, potatoes and fruits. Carbo-hydrates consist of the chemical elements carbon, hydrogen, and oxygen, but contain no nitrogen.

Fats are made up of the same elements as carbo-hydrates, but in different proportions. They contain less oxygen in proportion to their hydrogen. Now, the body contains a considerable quantity of nitrogen, while neither carbo-hydrates nor fats contain any; so that they cannot alone build up tissue but must always be combined with some proteid material. Their principal use is to be burnt up in the body, producing heat and enabling us to work, just as coal when burnt in the furnace of a steam-engine not only produces heat, but enables the engine to move and do work. Fats and carbo-hydrates are therefore called heat producers, as distinguished from tissue formers; but the term is misleading, for proteids, as we have seen, produce heat, and fats and carbo-hydrates help to form tissue. It is as if the fuel put into the furnace of an engine not only gave out heat and made the engine move, but repaired the wear and tear of the engine itself; so the food we eat serves as fuel to keep up the body heat and produce work, and also builds up the tissues of the body, which are continually wasting away.

Mineral matters are (1) water, (2) salts and vegetable acids.

Water makes up more than half the weight of our bodies, and we are continually losing large quantities by the kidneys, lungs, and skin, so that we can understand that water is as necessary or even more necessary to us than solid food; indeed, people can live for some time without solid food, as Succi's recent fast shows, but would soon die without water. We take in a large amount of water every day, for even if we do not drink any as such, the solid food we take contains about half its weight of water. Water is not only of use in helping to build up the tissues of the body, but also dissolves

the soluble part of the food, and so, as we shall see, aids in its digestion.

Salts.—The chief of these is common salt, which is added to some foods in cooking, and, besides this, is usually eaten with fresh meat and vegetables. Common salt contains the element sodium, and, besides this, we require salts containing the elements potassium, magnesium, calcium, iron, and phosphorus. These salts, with the exception of common salt, we do not eat alone, but get a sufficient supply of them in fruit, fresh vegetables, and fresh meat. These salts are contained in small quantities in the tissues, and seem to assist in the digestion of other foods. Disease results from their absence; thus, scurvy is supposed to be due to the absence of potassium salts. Scurvy was chiefly prevalent among sailors, who on long voyages were fed on salt meat without fruit or vegetables; but now that lime-juice and fresh vegetables, &c., are taken on long voyages the disease is almost unknown.

Vegetable acids, though not so essential as the salts mentioned above, are still very important. They are especially necessary for those who are engaged in sedentary occupations, since they purify the blood and assist the action of the bowels. They include acetic acid (vinegar), malic and citric acids (in gooseberries, currants, apples, &c.), tartaric acid (in grapes).

Besides these food-stuffs, which are necessary to sustain life, there are what may be called **food-adjuncts.** These are (1) beverages, to the consideration of which we shall devote a future chapter, (2) condiments and spices. These latter give food a pleasant flavour, increase the appetite, and aid digestion. The chief condiments are pepper, mustard, ketchup, horse-radish, capers, nasturtium seed. The chief spices are cinnamon, nutmeg, ginger, mace, allspice, curry powder.

Some of the food we eat is in the form of solid masses, and will not dissolve in water. In this form it cannot pass through the walls of the alimentary canal, but must be converted into substances soluble in water or other liquids, or else be very

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finely sub-divided. These changes in the solid food take place in the alimentary canal, and constitute digestion.

Digestion of Foods.—The alimentary canal consists of the mouth, pharynx, gullet or œsophagus, stomach, small intestine, large intestine, rectum.

Changes in the Mouth.—The solid food is chewed or masticated by the teeth, so that the digestive juices can more easily act on it, and is thoroughly mixed with the saliva, which moistens it and enables it to pass easily down the throat. Besides this, saliva has a special action on the starch in food. To understand this action, we must see what saliva is made of. Saliva is not pure water, but contains some mucus, which makes it slightly thick and viscid, like white of egg. Besides mucus, saliva contains a substance called **ptyalin**, which has the power of changing starch into sugar without undergoing any change itself. A substance which has this power is called a **ferment.** Yeast is a common example of a ferment. We put a little yeast into a barrel of fruit-juice, and after a time we shall find that we no longer have sweet fruit-juice in the barrel, but alcohol in the form of wine, and that our yeast is still there and will convert any amount of fruit-juice into wine. To test the power of ptyalin to convert starch into sugar keep a small piece of starch in the mouth for some time, when it will become sweet.

We have already said that the great object of digestion is to bring insoluble substances into a soluble form, so that conversion of insoluble starch into soluble sugar is a step in the right direction.

We can now see the importance of eating slowly, both that the food may be thoroughly broken up, so that the digestive juices may dissolve it more easily, and that as much starch as possible may be converted into sugar, otherwise extra work is thrown on the small intestine, where the conversion of starch into sugar is completed.

The food, mixed up with saliva into a round ball called a

bolus by the action of the tongue, is pushed to the back of the tongue and swallowed. It passes quickly through the gullet and enters the stomach.

Changes in the Stomach.—The mucous membrane of the stomach secretes an acid liquid called gastric juice. The food is thoroughly mixed with this juice by a churning movement of the stomach. This juice only acts on the proteid part of the food, converting it into a substance soluble in water. If we put a little bit of lean meat into artificial gastric juice made from a pig's stomach, we shall find that it will gradually disappear, and a clear liquid will remain. The ferment which brings about this change is called **pepsin,** and the soluble substance into which proteid is converted is called **peptone.** Pepsin can be obtained as a white powder from the stomach of a pig. It is sometimes eaten with food by persons suffering from indigestion.

Underneath the mucous membrane of the stomach are blood and lymph capillaries, into which pass the soluble peptone, and the sugar formed in the mouth together with some water.

The food is now a greyish mass of the consistency of soup, and is called **chyme.** It next passes into the small intestine.

Changes in the Small Intestine.—The pancreatic juice and the bile are, as we have seen (page 117), brought into the intestine by a common duct. The pancreatic juice contains a ferment which has the power of converting starch into sugar, and so finishes the work begun in the mouth by ptyalin. It contains another ferment, trypsin, which finishes the work of the stomach by converting any remaining proteids into peptones.

Besides completing the actions begun in the mouth, pancreatic juice has a fresh action of its own. It emulsifies fats. If we take a bottle with a little oil in it, and put into it some washing soda and some water and shake it up well, we shall get a white, milky-looking liquid, which is called an emulsion. If we examine some of this with the microscope, we shall find that the oil is broken up into very minute drops. Light cannot

get through this emulsion as it could through the unaltered oil, and so we get an opaque liquid instead of a transparent one. Milk is an emulsion, and its whiteness is due to this cause. When the fat (cream) no longer remains suspended in the liquid, but rises to the top, the milk beneath becomes much more transparent. Pancreatic juice, assisted by the bile, has this emulsifying action on fats.

When the pancreatic juice has been acting for some time, the grey chyme becomes converted into more liquid, cream-like material called chyle. It contains the products of the action of the pancreatic juice and bile, namely—peptones, sugars, and emulsified fat, together with indigestible food and any digestible food which the digestive juices may not be able to reach.

In the remainder of the small intestine and in the large intestine there are glands which secrete a digestive juice, the properties of which are unimportant. The chief work here is absorption. The proteids have been converted into soluble peptones, the starch into sugar, and both now pass through the mucous membrane of the intestine into the blood-vessels and lymphatics which lie beneath. The intestine is not like a tube made of glass or india-rubber, but more like an unglazed drain-pipe or flower-pot, through which water and substances in solution can soak. The fat has not been made soluble, but only broken up into very fine particles, which pass bodily through the mucous membrane. We do not quite understand how they get through. They pass through in such quantities, however, that after a meal containing much fat the lymph or fluid contained in the lymphatics is quite milky-looking. Hence these lymphatics have received the name of lacteals (Latin *lac*, milk).

All the indigestible parts of the food, and such digestible parts as have escaped the action of the juices, now pass on down the intestine and form the fæces.

We have now traced the food into the blood or lymph. The lymphatic vessels open into the blood vessels, so that all the

food, when digested, ultimately gets into the blood and is carried to the various organs, such as muscles, liver, heart, and nourishes them. At the same time, the blood takes away the waste products from these organs and carries them to the lungs, kidneys, and skin, where they are excreted or got rid of.

We must now consider how much of each of these food-substances or 'proximate principles,' as they are sometimes called, is necessary to maintain health. This we can do by finding the actual amounts eaten by healthy people, either by taking the average of the amounts eaten by a large number of people (say in some institution), or by individual experiment. By individual experiment we mean that a man eats such an amount of food that he neither gains nor loses in weight, and then finds out what amount of each food-substance he has taken. The results of these two ways agree pretty closely. We find that every 100 parts of the mixed food contain approximately—

Proteids	3
Fats	1
Carbo-hydrates	13
Salts	1
Water	82

About 100 ozs. of food substances, in the proportion given above, constitute a normal diet, *i.e.*, the amount of food which a man of average size and weight must take every day if he is neither to gain nor lose in weight and keep in good health. Of course individuals vary so much that it could not be known, without a trial, whether a given amount of food would be too much or too little for the needs of any particular person.

The proportion of the nitrogen contained in this normal diet to the carbon is as 1 : 13.

The only food which contains all the necessary food-substances is milk. It has on this account been called a perfect food. It contains in 100 parts—

Proteids	4
Carbo-hydrates ...	4
Fats	$3\frac{1}{2}$
Salts	$\frac{1}{2}$
Water...............	88

Milk is a perfect food for infants and is the *only* food that should be given to them for some months after birth, but on comparing it with our normal diet we find that it contains too little carbo-hydrate and too much water for an adult.

We have seen that proteid and mineral matter contain all the constituents necessary for the building up of the body, so that lean of meat, which consists of proteids, fats, salts, and water, would appear to furnish a suitable food. The proportions in 100 parts of lean of meat are—

Proteids............	22
Salts	1
Fats	2
Water	75

The normal diet, as we have seen, requires our food to contain 13 times as much carbon as nitrogen. Now, proteid contains only $3\frac{1}{2}$ times as much carbon as nitrogen, so that to get a sufficiency of carbon from proteid alone we should take in nearly 4 times as much nitrogen as we needed. To get rid of this excess of nitrogen would throw extra work on the kidneys and other organs and would lead to disease.

We can now see the reasons for the various combinations of food which man, without knowing anything of their physiological value, has been led by experience to adopt. Thus, we eat cheese, which is chiefly proteid, with bread, which is chiefly carbo-hydrate, but do not as a rule eat cheese with meat. So, too, we use milk in combination with bread, sago, rice, or potatoes, which are all starchy foods, and supply the carbo-hydrate lacking in milk, but do not usually take milk with

cheese. Eggs and bacon with bread or potatoes is another favourite combination, in which eggs supply the proteid material, bacon the fat, and bread or potatoes the carbo-hydrate. Examples might be multiplied, but it will be more useful to give a table showing the natural sources of the various food-substances.

FOOD-STUFFS	Proteids ...	Animal	1. **Albumin** of Eggs.
			2. **Myosin** of Muscle.
			3. **Casein** of Cheese.
		Vegetable	4. **Gluten** of Flour.
			5. **Legumin** of Beans.
	Fats	Animal	1. **Fat** of Butter, Meat, &c.
		Vegetable	2. **Oils** of Fruits, &c.
	Carbohydrates	Animal	1. **Glycogen** of Liver, &c.
		Vegetable	2. **Starch** of Flour, Rice, &c.
	Mineral Salts	**Common Salt, Lime, Phosphate of Lime, &c.**	

Gelatine is a nitrogenous substance, but is not a true proteid, and cannot take the place of proteid in building up the body. It is obtained by boiling bones and other parts of the body, and is generally taken in the form of soup, or as jelly or blancmange.

The question now arises as to the possibility of sustaining life and being healthy on vegetable food alone. We see from the table given above that plants are very rich in all the necessary food-substances, that nearly all the carbo-hydrates are obtained from vegetable sources, and that there are vegetable proteids and fats. Another argument in favour of vegetable food is that they contain an even larger percentage of proteid matter than do animal foods, as is seen from the following table. Vegetable foods have the further advantage of being much cheaper than animal foods.

	PROTEID	STARCH	FAT	SALTS	WATER	CELLULOSE	Cost per pound
Meat	20	0	2·3	·1	75	0	10d.
Peas	22·4	51·3	2·5	3·0	14·3	6·5	2d.
Haricots ...	23	52·3	2·3	2·9	14·0	3·5	2½d.
Lentils	24	49	2·6	3·0	14·5	6·9	3d.
Dry Potato..	2·3	18·4	·3	1·0	75	11·0	½d.

We see that peas, beans, haricots and lentils contain all the necessary food-substances in sufficient, indeed in even more than sufficient, quantity, so that there seems no reason why they should not be substituted for meat, especially as they are so much cheaper. The question is are they as digestible as meat?

The nourishment we get from food does not depend on the amount eaten, but on the amount digested and actually absorbed into the blood. Cheese contains a far greater percentage of proteids and fat than meat does, and forms a very nutritious food for people with strong digestion, especially for those engaged in hard work in the open air, but many people find it very indigestible, and therefore not nutritious. Peas, lentils, &c., also contain, as we have seen, a great deal of nourishment, but not in so digestible a form as in meat. The outer covering of peas, &c., consists of a material called **cellulose,** which is not acted on by the digestive juices, and passes out of the body unchanged. It is not only not acted on by the digestive juices, but it prevents other substances inside it from being acted on by them. This disadvantage may be got over by grinding the seeds and using them as meal, but even then they are not quite so easily digested as meat, especially by weakly persons. In spite of this disadvantage, it appears that life and health can be maintained on vegetable foods alone, as is shown by the number of 'vegetarians' at the present time.

In connection with this question of digestibility, we can study the uses of cooking food. It is a matter of every-day knowledge that a great deal of the value of food depends on proper cooking. Food was formerly eaten raw universally, and is still so eaten by savages and the lower animals, but civilised people always cook their animal food, or at any rate do not eat it absolutely raw.

The reasons for cooking food are—

(1) To make it more pleasant to the eye and agreeable to the taste. We might weigh out the requisite amount of each of the food-substances, mix them together,

and eat them without any further preparation, but such a mixture would have a very uninviting appearance, and also an unpleasant taste, and would therefore not be so readily eaten nor so easily digested as if each of the constituents was presented in a form pleasant to the eye and palate.

(2) To destroy parasites or minute animalculæ, which are often found in the flesh of animals. Thus, a disease called Trichinosis is produced by the presence of a parasite called *Trichina Spiralis*. Thorough cooking kills this and other parasites, so that no ill effects are experienced in England from eating 'measly pork,' but in Germany cases have occurred in which the parasite has survived the cooking process and has got into man's alimentary canal, causing a frightful disease. Of course, meat which contains these or any other parasites should not be used for human food; but good cooking is a sure safeguard if any be present.

(3) To bring about chemical or other changes in food, which make it more digestible. Thus, boiling and stewing make vegetables and fruit soft, and also meat, if properly conducted. Starchy foods consist of little grains of starch with a somewhat tough outer skin. When these grains are cooked this skin bursts, and allows the part inside to escape. On this account starchy foods are much more digestible when cooked than when raw. The fine, silky white substance which you sometimes see between the fibres of raw meat, and between the fat in suet, and which you have very likely heard called skin, is really connective tissue. It is wrapped round the muscle fibres, binding them together into bundles. When meat is cooked, connective tissue is converted into a soft, jelly-like substance called gelatine, which is soluble in water,

and is dissolved out in part by the water in which the meat is boiled, or by the gravy. The gastric juice can get at the muscle fibre more easily when the connective tissue is removed, and so cooked meat is more easily digested than raw.

(4) To provide variety of food. We want, as we have seen, variety in the food itself, but we can introduce additional variety by cooking the same food in different ways. The object of variety is to stimulate the appetite and give a relish for food, thus aiding digestion.

There are many different ways of cooking food, which may be classified under one of the following heads:—baking or roasting, stewing, boiling, frying, grilling.

Boiling.—This is a process which is applicable to most foods. No constant rule can be laid down with regard to the boiling of vegetables, but meat should always be put into boiling water. Meat contains a good deal of albumin, or substance like white of egg, which sets or coagulates when put into hot water, and forms a firm coating on the outside through which the water cannot penetrate. After a quarter of an hour or so, when the albumen on the outside is set, the water should not boil fast, but only simmer, so that the heat may gradually penetrate to the interior.

Boiling is the most economical method of cooking meat if the liquor in which it is boiled is also utilised to form the basis of soup, &c. If this liquor is not so used, roasting and baking are more economical methods.

If our object is to get all the 'goodness,' as it is called, out of the meat, as in making beef-tea or soup, we cut the meat up into small pieces, put it into cold water at first, and do not allow it to boil, for we want to dissolve out the albumen and the juice of the meat. If it boils the albumen coagulates, rises as a scum to the top, and is skimmed off and wasted.

Roasting and Baking.—The temperature is much higher

than in boiling. The same remarks apply to baking or roasting meat as to boiling it, *i.e.*, the temperature should be high at first to set the outside and prevent the juices from escaping, and then more moderate, so that the meat may be gradually cooked through. If the heat be too great after the first, the outside will be tough and burnt, and the inside not sufficiently cooked.

Stewing.—The meat is cooked in its own juices in this process, and little or no water is added. The heat applied must never be greater than that of boiling water. The fibre of meat is hardened by heat as great as boiling water, but if the temperature of the water be considerably less than that of boiling water, the fibre will be softened if the heat be long continued. The operation of stewing can with care be carried out in an ordinary saucepan by standing it on the hob and not allowing it to boil. An arrangement of saucepans like a carpenter's glue-pot is more effective. The outer saucepan only contains water, and the temperature in the inner saucepan never rises to that of boiling water. Such an arrangement is called a *bain marie.* A simple substitute for it can be made by standing a jar or jug in a saucepan of water. Stewing, if properly managed, makes meat more tender than any of the other methods of cooking. It is therefore especially applicable to the tougher joints of meat, and the flesh of old animals.

Broiling or Grilling.—This is a convenient and rapid method of cooking a small piece of meat, such as a chop or steak. The meat is placed on a gridiron over a clear fire. The meat is rendered very tender and digestible, but the method is somewhat wasteful, because the fat and some of the juices are lost, and it is difficult to perform this operation successfully.

Frying.—This is an appetising and speedy method of cooking many foods. Sufficient fat should be used to cover anything put into it, and the fat should always be boiling before anything is put into it. The article to be fried should be

coated with something which will prevent the fat reaching the interior. We generally use egg and bread-crumbs or batter for this purpose. We know that the fat is boiling when it is quite still and a blue smoke is rising from it. When it bubbles the fat is not boiling, but the water that is mixed with it, for water boils at 100° C., while fat does not boil till 350° C.

In boiling milk, or puddings, &c., containing milk, great care should be taken by stirring constantly to prevent the milk burning. Puddings containing eggs should not be allowed to boil, or the eggs will curdle. They are best cooked in a *bain-marie.* Eggs are more digestible when poached, *i.e.*, broken into boiling water, than when boiled or fried, for, especially in the latter case, they become tough and horny.

The digestibility of food, as well as its appetising appearance, depends greatly on the cooking; so that good cooking is a very important aid to keeping the body in good health, and is therefore rightly included in the scope of Hygiene.

CHAPTER II.

AIR.

Having seen that in order to be healthy we must have suitable food and pure water, we must now consider an equally important want, viz., fresh air.

Pure country air consists of a mixture of oxygen, nitrogen, carbonic acid and water-vapour in the following proportions:—

Oxygen ...	20·89	in 100 parts.
Nitrogen ...	79·1	,,
Carbonic Acid	·04	,,

Besides this there is some water-vapour which varies in amount with the heat of the air and from other causes, and a trace of ammonia. Ozone, which is a concentrated form of oxygen, and has great power of oxidising impurities, is found in air near the sea and in country places.

The amount of oxygen varies very little in different places, but is less in the air of towns, and the amount of carbonic acid is greater; thus while the amount of oxygen at the sea-coast is 20·999 per cent., in Manchester during frost and fog it only falls to 20·91 per cent.

Impurities in Air.—Though the air out of doors varies very little in the amount of oxygen and carbonic acid gas which it contains, in closed spaces the amount of these gases varies very greatly and many impurities may be present. An impurity is anything which is not present in pure country air, or which is present in greater amount than in pure country air.

1. Impurities in Air produced by breathing of Men and Animals.—While pure air contains (page 95) 20·89 per cent. of oxygen and ·04 per cent. of carbonic acid gas, air that is breathed out contains 16 per cent. of oxygen and 4 per

cent. of carbonic acid gas, the amount of nitrogen remaining unchanged; besides this the air breathed contains some organic matter which has a very fœtid smell though its exact nature is not known.

This breathed-out or expired air is poisonous if breathed over again, so that an animal shut up in a closed space to which no air is admitted, soon dies from want of air, we say; but really from want of fresh air, for there is plenty of air there. The tragedy of the 'Black Hole of Calcutta,' where 146 people were shut up in a small room at night and 123 were dead in the morning from suffocation, shows the effects of want of fresh air.

The injurious effects of expired air seem to be due to the deficiency of oxygen which it contains, and also to the presence of the fœtid organic matter of which we have spoken already. Whether the excess of carbonic acid gas has injurious effects in itself, except in so far as it keeps out oxygen, is uncertain. If the air breathed contains no organic matter and a sufficient supply of oxygen there are no injurious effects even if as much as 1 per cent. of carbonic acid gas be present, as in a soda-water manufactory, while in air which contains as much as ·15 per cent. of carbonic acid gas as the result of breathing produces headache and dizziness. These ill effects would seem to be due to want of oxygen and presence of organic matter. It is not easy to measure the amount of this organic matter present in any air, but the amount of carbonic acid gas can be measured, and is, therefore, taken as a measure of the organic matter present. When carbonic acid gas is present in the air of a room to the extent of ·07 per cent., the fœtid organic matter can be smelt, and we call the room 'stuffy'; when the carbonic acid gas rises to ·15 per cent. headache and dizziness result, and, if it goes on increasing, death by suffocation will follow.

Besides these definite ill effects, the continual breathing of air containing over ·07 per cent. of carbonic acid gas weakens

the general health and makes the person more liable to catch disease and less able to withstand it when caught. Consumption and typhus fever are much more general and more severe in their effects in overcrowded and badly ventilated places than elsewhere.

The breathing of animals and plants, as well as that of men, and the burning of fuel of all kinds, renders the air impure by taking from it oxygen and adding water-vapour, so that it would seem as though the amount of oxygen in the air must decrease while the amount of carbonic acid gas must increase, especially in the neighbourhood of large cities. We have however a purifying influence at work in green plants and trees, which in sunlight absorb the carbonic acid gas of the air and give off oxygen—the very opposite of the effects produced by animals.

2. **Sewage Gas.**—We have already spoken of the contamination of water by sewage matters and sewage gas. The gases given off from sewage matter may escape into the air instead of being absorbed by water, and will produce similar ill effects. The germs of cholera and typhoid may be conveyed in this way from one person to another, and in any case the breathing of such air weakens the general health and makes a person more liable to disease. The same remarks apply to the gas or effluvia arising from decomposing animal matter in graveyards, &c.

3. **Effluvia from Marshes.**—The air in the neighbourhood of marshes contains organic matters, and produces such diseases as ague and intermittent fever, besides diarrhœa and dysentery. It is not known how exactly these effects are produced, but they seem to be due to the decay of vegetable matter and disappear when the land is made drier by draining.

We now come to the impurities which are due to particular trades and occupations. These are principally of the nature of fine dust, as in coal mines, steel grinding works, pottery works, or fluff, as in cotton or wool trades, or the fine dust of flour

in mills. These impurities all tend to get into the lungs and to produce asthma, bronchitis, and other lung diseases. Workers in metals are liable to diseases produced by the dust or vapour of the metal. Chief among the metals which act thus are brass, mercury and lead. Lucifer match-makers suffer from a disease of the lower jaw caused by the fumes of phosphorus.

The injurious effects of these fine particles of dust and vapours of metals are very much lessened by sufficient ventilation, and by the workmen wearing masks over their mouths and noses.

We must now inquire what changes the air goes through from the time it enters until it leaves the lungs, for the air that enters the lungs contains usually about 20 per cent. of oxygen and ·04 per cent. of carbonic acid, while the air leaving contains only 16 per cent. of oxygen and 4 per cent. of carbonic acid gas. If we put a candle into a bottle it will go out after a time, and the air of the bottle will be found to contain more carbonic acid gas and less oxygen than formerly; indeed, the candle did not go out until it had used up all the oxygen. If we made two openings in the bottle, one by which fresh air could enter and the other by which the carbonic acid could escape, the candle would go on burning as well or better than if there was no bottle over it. What happens when a candle burns is, that the oxygen of the air unites with the carbon of the candle, forming carbonic acid gas, and with the hydrogen of the candle forming water; at the same time heat is given off sufficient to keep the candle burning.

A living animal may be compared to a candle. The tissues of the body (which correspond with the wax of the candle) are continually burning, *i.e.*, uniting with oxygen, and giving off carbonic acid and water. Heat is produced too, but not so intense as in the case of the flame of the candle; indeed, the temperature of the body never rises in health above 98° F. The animal, therefore, like the candle, continually requires a

fresh supply of air and dies if shut up in a closed space, just as a candle goes out.

Every part of the body requires oxygen, but oxygen only enters by the lungs, so that some carrier is necessary to take the oxygen to parts distant from the lungs, and to bring back the waste products, viz., carbonic acid and water, to the lungs whence they can escape into the air. The blood acts as the carrier. To understand how the blood does this we must learn something more about it.

To the naked eye the blood looks liks a red fluid, but if examined with a microscope it is found that the redness is caused by little red bodies—corpuscles they are called—floating about in a straw-coloured liquid. Besides the red corpuscles there are a few white ones, but we need not trouble about them just now. The redness of the corpuscles is due to a red substance, called hæmoglobin, which they contain. It is this hæmoglobin which carries the oxygen to the tissues. It is really a purple-coloured substance, but when it is in the presence of any oxygen it unites with it and forms a bright red substance called oxyhæmoglobin. We must now learn how the hæmoglobin gets its oxygen.

The blood is taken from the right ventricle of the heart by the pulmonary artery (P.A. Fig. 91) and goes to the capillaries of the lungs, which are very numerous and close together and form a sort of basket work round the outside of the air cells. The walls of the air cells are very thin, as are also the walls of the capillaries, so that the oxygen of the air easily gets through from the air cells into the capillaries and unites with the hæmoglobin of the blood, forming the bright red substance called oxyhæmoglobin. While the blood which came to the capillaries by the pulmonary artery was purple in colour, that which leaves them is bright red in colour, and passes through the pulmonary vein (P.V. Fig. 91) into the left auricle of the heart, thence into the left ventricle, and leaves the heart by the aorta (Ao. Fig. 91) which distributes it to all parts of the body. If an artery be cut

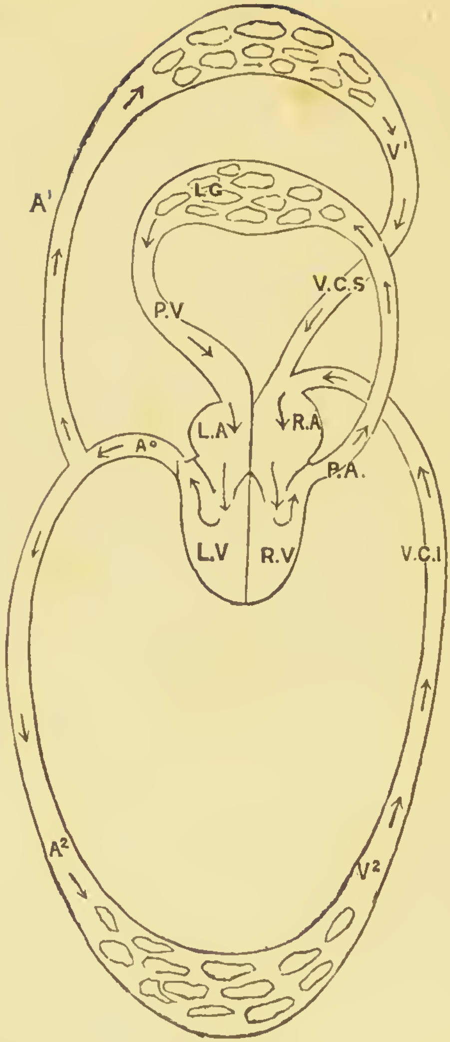

Fig. 91. Diagram showing Circulation of the Blood.

L. A. = left auricle.
L. V. = left ventricle.
Ao. = aorta.
A¹. = arteries to upper part of body.
A². = arteries to lower part of body.
V¹. = veins of the upper part of body.
V². = veins of the lower part of body.
V. C. I. = inferior vena cava.
V. C. S. = superior vena cava.
R. A. = right auricle.
R. V. = right ventricle.
P. A. = pulmonary artery.
Lg. = capillaries of the lungs.
P. V. = pulmonary vein.

in any part of the body, the blood which comes from it has a bright red colour.

The blood rich in oxygen passes from the arteries into the capillaries, which are very abundant in almost all parts of the body. Here the oxygen parts company with the hæmoglobin and unites with substances in the tissues to form carbonic acid gas and other waste products. The walls of the capillaries are very thin, so these waste products easily get into the blood, just as the oxygen easily got out of it, and are carried by the capillaries to the veins. The blood is now no longer bright red in colour but dark purple, because the hæmoglobin has lost its oxygen. It contains much more carbonic acid gas than the arterial blood does and is called venous blood. The dark purple colour of the blood in the veins shows through the skin, but when we cut a vein the blood that comes out is bright red unless the vein be large. This is because the oxygen of the air at once unites with the hæmoglobin forming, oxyhæmoglobin and making the blood red.

The blood passes through the veins into the right auricle of the heart, thence into the right ventricle, and leaves the heart again by the pulmonary arteries, which take it to the lungs, where it parts with its carbonic acid to the air in the air cells, taking up oxygen in exchange. So now we have traced the blood right round the body and have seen that it undergoes two changes in the lungs, viz., gains oxygen and loses carbonic acid gas.

This aëration, as it is often called, of the blood is so very important that if it is stopped for any length of time there is first a feeling of suffocation, and shortly afterwards death results. Suffocation is one of the commonest modes of death and is brought about by any obstacle which prevents the free passage of air into and out of the lungs. Hanging, drowning, poisoning by charcoal fumes are all forms of suffocation. The cause of death appears to be the want of oxygen and the accumulation of carbonic acid and waste products, just as the

candle goes out when it cannot get any fresh air. Since death results so quickly from the total exclusion of air from the lungs, we can easily understand that ill effects would result from breathing air which contains too little oxygen. The persons breathing such air are paler and not so strong as those breathing pure air. Compare the workers in factories with agricultural labourers.

We have already learnt that one of the chief ways in which air gets impure is by the breathing of men and animals; so much so, that if a man were shut up in a room, with all the openings by which air could enter closely stopped, he would soon die. We must now try to find out how much fresh air each person needs every hour, in order that the air breathed may be kept reasonably pure—*i.e.*, not contain more than ·06 to ·07 per cent of carbonic acid gas.

An average man breathes 16 times a minute and takes in and gives out at each breath about 30 cubic inches of air, so that in the course of a minute he has breathed in and out 480 cubic inches of air, and in an hour he has taken in and given out about 16 cubic feet of air. This respired air, as it is called, contains 4 per cent of carbonic acid, and if breathed again without dilution with fresh air would cause death. We want to dilute this respired air with so much fresh air that the mixture will only contain ·06 per cent of carbonic acid gas. It is found that it is necessary to supply nearly 200 times as much fresh air, or 3000 cubic feet per hour, in order to keep the air sufficiently pure. Very few people can get this amount of fresh air except out of doors. Hospitals allow 1200 cubic feet per hour for each patient, soldiers are allowed 600 cubic feet per hour each, police barracks 450 cubic feet, paupers 300 cubic feet, while the overcrowded poor only get about 250 cubic feet. (These figures apply chiefly to sleeping accommodation.) Not only is sufficient cubic space necessary, but there must also be sufficient superficial space or floor space. Height will not make up for want of superficial area, as is seen by the

fact that people are suffocated out of doors, in a crowd, where the cubic space is unlimited. The superficial space for each person should not be less than 42 square feet. Hospitals provide about 90 square feet for each patient, soldiers have 50 square feet, while board school children have only 10.

It is evident that the less the air space the oftener does the air require changing, in order to keep it at the proper standard of purity. Thus a room 10 feet every way would provide a person with an air space of 1000 cubic feet, so that the air would require to be completely renewed three times an hour. In our country, at least, it is seldom possible to renew the air of a room oftener than this, consequently each person should have an air space of 1000 cubic feet. Moreover if the air space be less than this the inlet and outlet of air are too near the person occupying the room, and discomfort and draught are felt, or a through current gets established between entrance and exit so that the air in the rest of the room is little affected. To renew the air of a room sufficiently often without creating unpleasant draught is the great and unsolved problem of ventilation.

CHAPTER III.

VENTILATION.

Ventilation may be natural or artificial. Natural ventilation is carried on by taking advantage of the movements brought about in air by diffusion or by difference of temperature.

Diffusion.—This is a property of gases in virtue of which they spread through the whole of an available space. Thus a very small quantity of a strong smelling substance, say eau de Cologne, can be smelt in every part of a large room. So the air laden with carbonic acid gas which we breathe out diffuses itself through the surrounding air instead of accumulating round the person breathing it, and this is partly the reason why the air in towns differs so little in composition from country air. If the air in a living room be put into free communication with the external air, as by wide open doors and windows, the fresh air gradually diffuses in and the impure air out. Diffusion goes on even if the air inside and out be of exactly the same temperature. Diffusion is, however, a very slow method of ventilation, and is not of itself sufficient to keep the air of an inhabited room pure, unless there be very free communication with the external air. This is seldom possible, especially in winter. Far more important for ventilation are the movements brought about by differences in temperature, and these we shall now consider.

The air we breathe out has the same temperature as the body, viz., 98° F., and is, in this country at least, always hotter than the surrounding air. Warm air is, bulk for bulk, lighter than cold, and therefore rises above the cold, so that in a room the hot air is above and the cold below. This hot air escapes through any available opening, and cold air enters to supply its place through the window, cracks in the door or keyhole. In this way a current of air is established in a room which is warmer than the outside air. Just in the same way currents called winds are produced in the atmosphere and with diffusion keep the composition of the air uniform in all parts of the world.

Winds are very efficient ventilating agents. The air in a room can be purified very thoroughly by allowing a cross current to pass through it from one side to the other by means of two windows opened opposite to each other. Winds are not very reliable as ventilating agents, for sometimes the air outside is stagnant and there is little cross current, and at others the air moves so rapidly that a great draught is created. Such a method of ventilation is not available while a room is inhabited, but is very effectual where thorough purification is desired. Another way in which winds assist in ventilation is by taking some of the air out of the top of a chimney as they pass across, leaving an empty space which is filled up by air from below, and thus an upward current is created.

All that is really necessary for ventilation is to provide an aperture near the ceiling through which the heated and impure air can escape, and another aperture through which the colder air can enter. Two apertures are necessary to create a thorough draught as is shown by the following experiment. Stand a lighted candle in a saucer with a little water in it, and put over the candle an ordinary lamp glass. The water will prevent any air from entering below, and the candle, in spite of the free opening above, will soon go out. If now a piece of cardboard be arranged so as to divide the opening at the top

into two, the candle will burn steadily. The hot air now passes out at one side of the partition while the cold enters at the other. A window open at both top and bottom, or one that opens so as to divide the space into two obliquely, is much more efficient as a ventilator than a window open only at top or bottom. Still better ventilation is effected by having the outlet and inlet on opposite sides of the room.

Outlets.—The opening of the chimney acts as an outlet, and there is, especially in windy weather, an up current which draws up the air. The disadvantage of this opening is that it is too low, for the heated and impure air goes to the ceiling. It is better, therefore, to have an opening into the chimney near the ceiling closed by a light mica valve which opens inwards, so that though the air can pass in, the smoke, &c., cannot pass out, or to have some perforated bricks near the ceiling communicating with the outside air.

Inlets.—The difficulty is to let in sufficient fresh air without creating a draught. When a window is simply opened at the top, the cold air being heavier falls downwards and on to the heads of the people who may be under the window. Various contrivances have been made for letting in fresh air without causing a draught.

(1) By having a window made so that it opens inwards, thus directing the entering current of air upwards.

(2) By raising the lower sash two or three inches and filling in the opening with a piece of wood. A space is thus left between the two window sashes and the entering air is directed upwards.

(3) By taking out a pane and putting a louvre in its place. A louvre is made by arranging strips of glass like the laths of a venetian blind. The louvre can be closed or opened at pleasure, and when open directs the entering air upwards. A venetian blind can be made to serve the same purpose by turning the laths upwards.

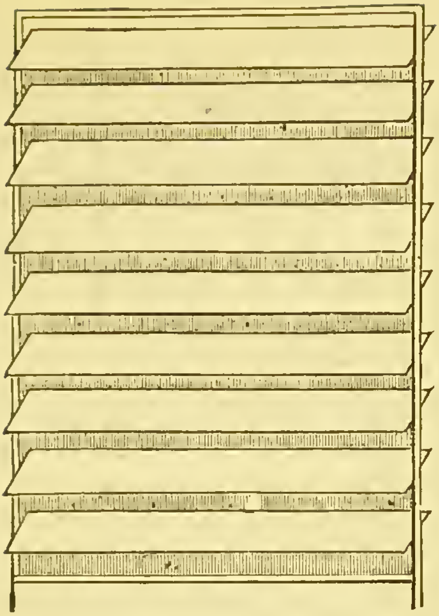

Fig. 92. Diagram of a Louvre.

(4) Perforated bricks can be used as inlets as well as outlets.

(5) Tobin's tubes are vertical tubes which can be carried up to any height and direct the air upwards. They are useful in rooms when a cross current is desired and is not provided for by windows or chimney.

Artificial Ventilation.—The commonest method of artificial ventilation in this country is by means of an open fire. Grates, as commonly constructed, are not economical for warming purposes, and not as efficient as they might be for ventilation. The cold, air rushes in through the window or under the door, entering the centre of the fire, causing it to burn very rapidly, and when warm passing up the chimney. This rush of cold air with the draught that it causes can be prevented in great measure by closing the space beneath the grate by a close fitting iron door, or by making the bottom of the grate of solid fire bricks. The former plan is preferable, because the door can be opened while the fire is being lighted

or at any time when a good draught is required. But even with a grate constructed in this way a great deal of heat—$\frac{7}{8}$ of it—passes up the chimney and is wasted. Special grates have been made with an arrangement for using some of this waste heat. We will describe the general arrangement of such a grate.

At the back of the stove or grate there is an air space which opens to the outside air by perforated bricks or gratings. The air in this space, heated by the back of the stove and by the flue for the smoke which passes through it, enters the room by an opening somewhere between the fire place and ceiling. In this way the fresh air is warmed so that no draughts are produced.

An ordinary stove standing out in a room is more economical as a source of heat than an open fire; but the heat gets through the sides, drying the air and making it unwholesome. This can be partially remedied by placing a pan of water on the top of the stove.

Large buildings can be both warmed and ventilated by hot water pipes. The fresh air enters over coils of hot pipes and at the outlets or extraction shafts are other coils of pipes which make an upward current and draw out the impure air.

Mines are often ventilated by two shafts, one for the entrance of fresh air; the other has a furnace burning at the bottom which creates an upward draught and extracts the impure air.

A single gas burner uses as much oxygen per hour as three or even five men, and gives off carbonic acid gas, together with sulphuretted hydrogen, sulphur dioxide, and carbonic oxide, all of which render the air of a room impure, and should not be allowed to enter the room. To carry away these products of combustion, a tube, communicating with the chimney or outside air, should be fixed over the gas jet. This not only takes away the products of combustion, but also the heated and impure air in the upper part of the room; for the gas jet heats the air and produces an upward current.

CHAPTER IV.

THE TREATMENT OF SLIGHT WOUNDS AND ACCIDENTS.

The treatment of slight wounds and accidents does not strictly fall within the domain of hygiene; but a knowledge of how to render first aid to the wounded is so often of service in preventing serious mischief later, or even death, that a few simple directions are given here. In any serious accident or case of illness first aid only should be rendered and a doctor should be summoned. More harm than good often results from the attempt to treat serious cases without medical advice.

Among the most commonly occurring accidents are:

Cuts.—If made with a sharp knife, or piece of glass, or any other sharp instrument, the cut should be examined to see if any dirt has got into it, or fragments of glass, and these should be carefully removed by washing, after which the wounded part should be simply tied up with clean dry linen rag, or better still with a pad of lint and a bandage over. The blood will form a clot and join the edges of the cut together, and it will soon heal. If the bleeding is excessive, measures must be taken to stop it before anything is done to the cut itself. This will be explained later.

If the cut be made with a blunt instrument, as with a nail, or by stones or gravel so that the skin is much torn, all the dirt should be carefully removed with a sponge and lukewarm water; the edges of the cut should then be put into position, and the cut be tied up with rag or lint soaked in cold water, over which is put a piece of oiled silk (if at hand) and a piece

of dry rag, handkerchief, or bandage. Such wounds will take longer to heal than simple cuts, and there will often be some gathering.

Deep and extensive cuts should be treated by a doctor, as it is often necessary to put in a stitch to bring the edges together, and when on the face or head to prevent an unsightly scar.

Bruises.—These should be treated with cold applications, water or alcohol if nothing else be at hand. The rag should be kept wet, and therefore should not be covered up with oiled silk, but the moisture should be left to evaporate. An ice-bag, *i.e.*, ice tied up in a bag made of waterproof material and allowed to rest on the bruise. Arnica is useful in relieving pain and preventing discoloration, but is somewhat dangerous and should never be used if the skin is broken. A bruised arm should rest in a sling, and a leg be kept raised if the bruise be at all severe.

Burns and Scalds.—These are also very common accidents. If a person's clothes catch fire they should lie down on the floor and roll over and over, wrapping round them at the same time carpet, hearthrug, or anything that may be at hand, the object being to extinguish the flames by excluding air. On no account should the person rush about the room or passage, for in this way the flames get a free supply of air, and the burning goes on more fiercely. When the flames are extinguised the person, if severely burnt, should be wrapped in blankets and kept near the fire, and warm brandy and water given until the doctor arrives, for the shock of a severe burn is very great and the main object is to keep up the strength.

In the case of less severe burns or scalds, wrapping the part in cotton wool relieves the pain and excludes the air, but the wool tends to stick if the skin be broken. It is better to put on zinc ointment spread on rag or lint and then cotton wool. The great object is to exclude the air, so flour dusted on, or linseed or castor oil, or even soap, may be applied. A burn of any size should never be left uncovered even if it does not look

serious at first, for blisters may form and burst, leaving a raw place difficult to heal.

Bleeding.—Slight bleeding, as we have seen, soon stops by a clot being formed, and if the cut have dirt or foreign matter in it, some bleeding will do no harm since it will wash the cut. If, however, the bleeding is considerable, measures should be taken to stop it. Severe bleeding may be (1) from a vein; (2) from an artery. (The bleeding from a surface cut is from the capillaries). There are various points of difference between cuts, according as they have gone through a vein or an artery. The blood from a vein flows out from the side of the wound away from the heart in a continuous steady stream; *i.e.*, if the cut be in the arm the blood will come from the fingers. The color of the blood is, as we have seen, a dark purple. The blood from an artery, on the other hand, comes out in jerks corresponding to the beat of the heart, and chiefly from the side next the heart. It is of a bright red color. If the blood is coming from a vein we apply pressure on the side away from the heart because the veins are taking blood back to the heart. If the blood is coming from an artery we apply pressure on the side of the wound next the heart because the artery is taking blood from the heart, and we want to stop the flow from this particular artery. Pressure can be applied by the finger, especially in the case of an artery. The position of the main artery can generally be determined by its throbbing or pulsation, and firm pressure should be made on this with the finger *above the wound.* Meanwhile an assistant should make a pad of lint or rag and put this on the wound, and should fasten this pad on by a handkerchief or bandage put very tightly round, holding the pad in position with his thumb. If now the bleeding stops, the finger can be removed from the artery above the wound. If the bleeding is severe, and it cannot be determined whether it comes from an artery or vein, it should be treated as if from an artery. If the bleeding is only from a vein, a pad and bandage is generally sufficient.

A surgeon would use a tourniquet instead of his finger to stop the bleeding. A very effective substitute may be made by tying a handkerchief or bandage loosely round the limb, and then putting a piece of stick under the bandage and twisting it round and round.

Bleeding from the nose can generally be stopped by keeping the head back and holding a sponge soaked in cold water to the nose. The head should not be held down over a basin. If this is not sufficient to stop the bleeding after a reasonable time, a doctor should be called in.

Bites and Stings.—These are best treated by sucking the wound, if not too large, to get out the poison (which should, of course, be spit out), or applying a caustic, if at hand. The bleeding should not be checked, unless excessive, as it may wash out the poison. In the case of a sting by an adder, a tape should be tightly tied round on the side of the wound nearest the heart, and the wound should be sucked. Stimulants, such as sal volatile or brandy and water, should be given.

Drowning and Suffocation.—The object in both cases is to restore the action of the heart and lungs by 'artificial

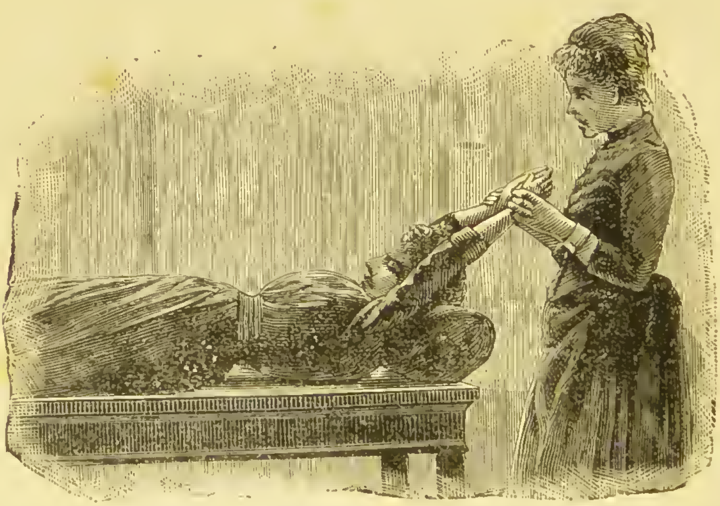

Fig. 93. Showing 1st Position of Artificial Respiration.

respiration.' We will describe one method of artificial respiration. The mouth should be cleared of water, &c., the tongue drawn forward and held in that position, and the patient should be laid on his back with the head and shoulders slightly raised. The operator should kneel behind the head and take hold of the arms just above the elbow and draw them steadily and slowly up till they meet above the head. By this means the ribs are pulled up, the cavity of the chest enlarged, and air enters the lungs. The arms should be then brought down to the side of the chest so as to press it in and press some of the

Fig. 54. Showing 2nd Position of Artificial Respiration.

air out in imitation of expiration. These movements should be repeated sixteen to twenty times a minute and should be continued for half an hour if the patient's natural breathing is not restored before that time. Rubbing with warm towels is also useful but should not be performed until the respiration is restored. Dashing with cold is also useful, particularly in suffocation.

Poisons.—The substances that may be taken as poisons are so numerous and varied that it is impossible to give directions

for treatment in all cases. A simple emetic, such as mustard and water, salt and water, or simple warm water, may be given in almost all cases. A stimulant, such as brandy and water or ammonia, may also be safely given if there is great weakness or faintness.

In cases of poisoning by acids or alkalies emetics should not be given, because the lining of the stomach and œsophagus is injured or destroyed by the acid or alkali and emetics will only cause irritation.

In case of poisoning by acids, magnesia or chalk (scraped from the ceiling if no other be at hand), or soap and water, should be given, together with oil. The object being to neutralise, and render harmless, the acid.

In case of poisoning by alkalies, vinegar and water, or lemon juice with olive oil, should be given.

We will now give in a tabular form a list of the more commonly occurring poisons, with the treatment in each case:

Prussic Acid.	Smelling Salts, Artificial Respiration, Dashing on cold water.
Arsenic.	Emetics, Lime Water, Sugar and Water, Oil.
Mercury.	Whites of Eggs, Soap and Water.
Lead.	Epsom Salts, Castor Oil, Emetics.
Copper.	Whites of Eggs, Gruel.
Hemlock Night Shade Foxglove	Emetics and Castor Oil, Brandy and Water.

CHAPTER V.

DRESS.

In former times universally, and now among savages, clothes were only worn for the sake of warmth, and were generally of a very simple kind, being the skins of the animals killed for food. We have found no substitute for these skins for keeping out the cold in Arctic climates, but in temperate climates woven materials have taken their place. Woven materials are usually woollen, cotton, linen, or silk.

The main object in wearing clothes is to *keep in* the warmth of the body. Some people talk as though clothes warmed us like the sun and fire, but they do not. All they can do is to keep in the heat which the body itself makes; for the tissues of the body, as we have seen, are continually burning and producing heat. The best material for clothing, then, would seem to be the one which allowed least heat to escape.

There are several ways in which heat may escape from the body. These are called radiation, conduction, evaporation. The heat that comes from the sun to the earth comes by *radiation*—*i.e.*, it passes straight from sun to earth and warms the intervening air very little. So, too, the heat from a fire radiates into a room. If we stand a teapot on a wooden table, or better still, on a woollen mat, it will lose its heat by radiation, and presently get cold, but if it is covered by a cosy it keeps warm much longer. The cosy prevents loss of heat by radiation. If we stand the teapot on a stone or metal table it will lose its heat much more rapidly, for heat escapes by *conduction* as well as by radiation. Stone and metal are better conductors than wood and wool. By conduction, we mean that the heat passes

from particle to particle of a body. A third way in which heat may be lost is by *evaporation.* If we wet our hands and wave them about in the air to dry, they feel cold, and if we wet them with alcohol or ether they feel still colder. The reason is that a liquid, when it dries, really passes off in vapour and requires some heat to turn it into vapour, which heat it takes from any neighbouring substance, in this case the hands.

The best material for clothing would, then, appear to be the one which would best prevent loss of heat by radiation, conduction, or evaporation. Indiarubber, in the form of mackintosh, fulfils all these conditions, but, as is well known, is not a comfortable dress for ordinary wear for this reason, that though we may check loss of heat by conduction and radiation to any extent and still be comfortable, we cannot check loss of heat by evaporation without also checking evaporation itself. Some of the waste products of the body (chiefly water with some carbonic acid gas), escape from the body in the form of perspiration or sweat, and this, in drying or escaping as vapour, takes heat from the body. If, however, it is not allowed to escape, it accumulates on the surface of the body, making us wet and uncomfortable, and besides, to a certain extent, poisoning us with the fœtid organic matter which it contains. Mackintosh, then, is not sufficiently porous to serve as a material for ordinary wear. Fur is the best non-conductor of heat we can get, but is not sufficiently porous to be worn constantly, except in very cold countries. Silk stands next to fur as a non-conductor of heat, but it is not sufficiently absorbent, and is too expensive for ordinary use. The three remaining materials—wool, cotton, linen—stand in the order named in respect to their power of preventing loss of heat by conduction and radiation. We should, then, choose wool as a material for clothing if we found that its porosity was as great as, or greater than, that of linen or cotton.

It is found that wool is more porous than either cotton or linen, and that it is also absorbent, *i.e.*, soaks up from the skin

any moisture which has not escaped by evaporation, and then the evaporation goes on from the surface of the wet wool instead of from the surface of the skin, thus preventing the chilly feeling that follows violent perspiration, and the subsequent tendency to catch cold. Another advantage that wool has over cotton and linen is its rougher surface, because in this rough surface air gets entangled, and this air getting heated forms a warm atmosphere round the body. Linen and cotton have generally a smooth surface. Wool is the best material for wearing in winter, because it keeps us warm, and at the same time comfortable, and for summer because it absorbs the perspiration and prevents the too rapid loss of heat after violent exercise.

Since the main object of clothing is to keep in the body-heat, not only should the trunk of the body be covered, but also the limbs, and this covering should be as far as possible of equal thickness all over the body.

Another very important point is that clothing should not be tight, for tight clothing impedes the circulation (*e.g.*, cold feet are often the result of tight boots), and may press on some of the important organs in the body, causing disease. Tight lacing is the most prominent example of tight clothing, but any garment that is so tight as to impede the free movement of any part of the body is injurious in a degree. But in avoiding tight garments, care must be taken not to go to the opposite extreme and have them too loose, because they then hang more or less from one part, *e.g.*, the shoulder or waist, and tend by their weight to press on these parts. Clothing should press equally on all parts.

The amount of clothing worn will, of course, depend on the heat or cold of the weather. The body should, if possible, be so clothed as to be comfortably warm. If the body is too thinly clad in cold weather, a chill, and possibly disease, will result; if too warmly clad in warm weather, the body is overheated and weakened. Grown up people are able to regulate

the heat lost by the body in such a way that the body-heat is always the same—98° F.—except in fever or prolonged exposure to cold. Clothes should assist this regulating power of the body, *i.e.*, in winter should be thick to keep in the body heat, in summer thin, to allow it to escape.

Children's Clothing.—Children, especially very young infants, have not this power of keeping up their body heat, and rapidly lose heat if exposed to the cold air. It is, therefore, specially important that infants should be warmly clad in cold weather so as to keep in as much as possible of the heat of the body. They should be covered all over with the same thickness of clothing, so that no one part of the body is warmer than another. Only the hands, head, and neck should be exposed.

We have seen that in the case of adults clothing should not be tight, and should press equally on every part, so as not to drag down any particular part by its weight. This is still more important in the case of infants, who are growing very quickly and require plenty of room for their growing organs to expand; but the clothing should not be so loose that all its weight hangs from any one part, because children's bones are soft and easily put out of shape by continued pressure. Besides this, children's clothing should be as light as it can be while being warm at the same time. Wool is warmer, and also lighter, than either linen or cotton, and is therefore the best material for clothing children as well as grown up people.

Boots.—These should be made the same shape as the foot; but it is very difficult to get bootmakers to do this. Boots need not be square-toed nor too large in order to be 'rational' and

Fig. 95. Natural Foot.

'hygienic,' but there should be an almost straight line along the inner side of the foot to the end of the great toe, and then the boot can be sloped off as usual, leaving sufficient room for the other toes. Boots are usually made with both sides sloping equally to a point in the middle of the toes, pressing the great toe towards the others into an unnatural position, and causing it in its turn to press on the other toes. Boots should be made not too loose, but so as to exert equal pressure on every part of the foot. If extra pressure is exerted on any one part, a corn will grow there. Heels should not be high or narrow, but flat and broad, so as to afford a firm basis for the foot to stand on. High heels are dangerous, because they throw the wearer forward into an unnatural position and cause pressure on the internal organs. There is also great danger of stumbling.

CHAPTER VI.

WATER.

We now come to the subject of water and will first consider the sources from which we get our supply.

Rain-water is the ultimate source of all the other water supplies, such as springs, wells, and rivers. The vapour from the sea and other sheets of water gets condensed in the atmosphere and falls as rain. Rain-water collected in the neighbourhood of towns and villages is seldom used except for washing purposes. It is pure when first formed; but in its fall through the air dissolves out various gases, such as ammonia and sulphuretted hydrogen (if any be present), and collects some of the dust that may be floating in the air. Besides this, it takes up all the impurities which it meets with on the roofs and other

places where it falls, so that when it is collected it has a smoky disagreeable taste and is very 'flat' because it contains little air in solution.

Of the water which falls on the land as rain some (1.) runs along the surface into rivers or ponds. (2.) Some sinks into the ground, the depth to which it sinks depending on the nature of the rocks (or *strata* as they are called) below the soil. Thus water will sink through sandstone or gravel or chalk but not through clay, and hence clay soils are very wet unless well drained, while sandy soils are very dry. We therefore call clay impervious, sand pervious. Where an impervious stratum such as clay is immediately under the surface, or where some pervious material such as sand or gravel lies in a thin stratum over an impervious stratum, the water collects and forms a well wherever a hollow occurs. Such a well is called a surface well. If, however, we have a great thickness of pervious rock immediately under the surface, the water sinks down deeply until it reaches some impervious stratum. It may run for miles below ground but often reaches the surface again either by means of a spring or by means of a deep well. Springs generally occur on the slope of a hill where the strata come to the surface (see fig. 96), or the water gets up through a 'fault' in the strata. Deep wells are borings made to reach the underground water

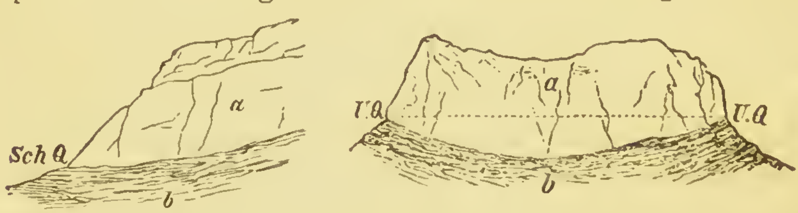

Fig. 96. A. *a*, chalk; *b*, impervious clay; *Sch. Q.*, point where the spring issues.

B. *a*, chalk; *b*, impervious clay; *U.Q.*, springs issuing at either end of the saturated portion of the chalk.

which seeks the level of its source, and may rise to the surface or even overflow if the boring be made in a sufficiently low-lying spot. The value of these different sources of water

supply will now be considered. The quality of river and surface well water will depend chiefly on the character of the soil over which it flows, while the quality of spring and deep well water depends chiefly on the character of the rocks through which it flows.

River Water.—If the water which supplies the river has flowed over uncultivated land, such as mountain, moor, or heath (upland surface water), it is tolerably pure and furnishes a good water supply. It will contain some impurities of vegetable origin, especially if it has passed through marshy districts, but nothing of a really dangerous character. If, however, the water has flowed over cultivated land, it will contain impurities dissolved out from the manure on the land. The chief source of impurity, however, is the sewage drained into it by the towns and villages on its banks, so that water collected lower down in its course is unfit for drinking purposes unless carefully filtered and purified.

River-water is constantly moving and therefore fresh portions of it get exposed to the air, which has the property of oxidising or burning up, and in that way rendering harmless, the organic matter; but this purification is only possible to a limited extent, and is not sufficient to purify water which has received a large amount of sewage matter—*e.g.* the Thames. If, however, the choice be between river and lake water from similar sources, river water is to be preferred; because it is constantly being exposed to the air while lake water is more or less stagnant.

Surface Well Water.—Surface well water is pure and good for drinking purposes if the well receives its supply from uncultivated land. As a rule, however, surface wells are situated in the neighbourhood of cultivated land and of houses, and are contaminated by substances dissolved out of the land and by sewage soaking into them from neighbouring cesspools, pigsties, &c. In such a case they are quite unfit for drinking purposes.

Deep Well Water and Spring Water.—The water

from these sources is free from organic matter, unless some gets into it by drainage from the surface. It generally, however, contains a large amount of mineral matter in solution, which makes it 'hard,' or may be present in such quantity as to constitute 'mineral waters,' *e.g.*, the sulphur springs at Harrogate and the iron springs at Cheltenham. The water from these sources, with the exception of mineral waters, is very valuable for ordinary drinking purposes. It is clear, colourless, and agreeable to the taste, besides being almost free from organic matter.

Any foreign matter whatever which water contains constitutes an impurity, though all impurities are not necessarily harmful. An impurity which renders water valuable for drinking purposes is air or other gases in solution. When we boil water we drive out the air or carbonic acid gas and in consequence the water after boiling tastes flat and insipid. Rain water and distilled water, which latter is obtained by boiling ordinary water and condensing the steam, contain little or no air or other gas and are consequently 'flat' to the taste.

Water from the other sources mentioned above contains varying amounts of air, carbonic acid gas and other gases. These gases are dissolved out by the water during its passage through the air, over the soil, and through the rocks, for all soils and many porous rocks contain large quantities of gases in their interstices. In springs the gas is often contained in the water under considerable pressure and escapes as bubbles when the water is exposed to the air, just as the carbonic acid gas escapes from a bottle of soda water when it is opened.

Water which contains a considerable amount—20 grains in a gallon—of mineral matter dissolved in it is called **hard,** while water containing little or no mineral matter—3 or 4 grains —is called **soft.** Epsom salt (magnesium sulphate) and gypsum (calcium sulphate) are somewhat soluble in pure water and are not thrown down as a white deposit when the water is boiled. On this account they constitute what is termed **per-**

manent **hardness.** Magnesium carbonate (dolomite) and calcium carbonate (chalk, limestone) are not dissolved by pure water, but are dissolved by water containing carbonic acid gas in solution. If we boil such water (*e.g.*, London water) the carbonic acid gas escapes, and the chalk sinks to the bottom as a white deposit constituting the 'fur' on kettles and boilers. The hardness produced by the presence of the carbonates is called **temporary hardness** because it can be removed by boiling. Water of moderate hardness, *i.e.*, containing 10 to 15 grains in every gallon, is quite good and wholesome for drinking purposes, though some few people may be injuriously affected by it. An excess of magnesium salts in drinking water is thought by some to give rise to a disease called goitre, the chief symptom of which is a swelling in the neck. This disease is only found in districts where the water contains magnesium salts.

Though hard water is not injurious for drinking purposes, it is very unsuitable for manufacturing purposes and for domestic purposes such as cooking and washing. (1.) It deposits 'fur' on kettles and boilers, not only filling them up but also preventing the heat from getting to the water as readily as it would otherwise do, and so requiring extra fuel. (2.) It does not draw the 'strength' out of tea so well as soft water, and hence we require to use more tea to produce an infusion of the same strength. Vegetables, especially greens, do not cook so well in hard water, and the 'fur' tends to collect on them instead of on the sides of the vessels, giving them a whitish appearance. (3.) For washing purposes hard water is very unsuitable and wasteful. Every one knows how soap curdles in hard water and floats on the top as a scum, and how if they want to get a lather on their hands they just wet them in the water and then rub on the soap, for the lather disappears if much water is used. All the soap that thus curdles and floats on the top of the water is just so much waste, as far as cleansing effect is concerned. Soap is a chemical compound of soda and fat, or of potash and

fat, and is soluble in pure water, forming a lather. The lime and magnesia contained in hard water act on the soap uniting with the fatty part of it. This compound of fat, and lime or magnesia is not soluble in water and forms the scum on the top, and it is not until all the salts of lime and magnesia are used up in this way that the soap can exert its proper action and form a lather, or, in other words, the soap must first soften the water before it can form a lather. This softening of the water by soap involves great waste of soap. The inhabitants of Glasgow find that the amount of soap they use is only half as great as formerly because they are now supplied with soft water (2 grains of mineral matter per gallon) from Loch Katrine, whereas they formerly used hard water.

We measure the hardness of a water by finding how much of a standard solution of soap is needed to form a lather. The amount of hardness is often expressed as grains per gallon; thus the water at the following places contains—

Bangor............	$\frac{1}{5}$ grain	per	gallon.
Glasgow water...	2 grains	,,	,,
London ,, ...	18 ,,	,,	,,
Gravesend ,, ...	20 ,,	,,	,,

Metallic Impurities.—These are principally iron and lead. Iron, if present in sufficient quantity to give a distinct taste to the water, produces headache, besides rendering the water disagreeable for drinking purposes. When present in minute quantities however it appears to be harmless. **Lead,** if dissolved in water even in very small amount—$\frac{1}{20}$ grain per gallon—may give rise to symptoms of lead-poisoning, for the small amounts accumulate in the body. Lead is generally derived from the cisterns in which water is stored or the pipes in which it is conveyed. Soft water and water containing organic matter has far greater action on lead pipes than hard water. The carbonic acid contained in hard water unites with some lead and forms lead carbonate, which is deposited on the inside of the pipes in the form of a thin film

and protects the lead beneath from further action of the water.

Organic Matter may be (1) of vegetable origin, (2) of animal origin.

Vegetable Organic Matter may be present in water in solution, or floating about in the water; if the latter, it can of course be easily removed by filtration. Water containing vegetable matter is often brownish in colour and has an unpleasant taste. If the impurities of this nature do not exceed two grains per gallon the water is not actually unwholesome, but should not be used for drinking purposes if a purer supply can be obtained. Its quality is improved by filtering through sand or gravel and by exposure to the air. If however there is a large amount of vegetable matter in the water, it is unwholesome and may produce diarrhœa or ague. River and shallow well water are the most likely to contain vegetable matter derived from decaying vegetation or from peaty soil.

Animal Organic Matter.—This is by far the most dangerous and widespread impurity found in water. It gets into the water of a well or river by soaking through from neighbouring cesspools, sewers, pigsties, heaps of manure, privies, or is washed off the manured land by the rain, or gets in by actual drainage of sewage matter into a river. The foul gases given off by sewage matter may also be taken up by drinking water, as we shall explain later on. Water contaminated by sewage matter is always dangerous for drinking purposes. It may produce diarrhœa, low fever, and sore throat, and in all cases causes a more or less weakened condition of bodily health, which renders the person more liable to catch any disease that may be prevalent. The worms found in the intestines are probably often introduced by impure water.

But by far the greatest danger in the use of water contaminated by sewage matter is that the germs of certain diseases, such as cholera and typhoid fever, may get into the water by means of the sewage and so be communicated from

person to person. It is generally believed now-a-days that infectious diseases are connected with, if not caused by, the presence in the body of minute animalculæ called bacteria. These bacteria grow and multiply in the body of the sick person and pass out with the excreta. If the sewage matter containing these excreta is allowed to drain or soak into the drinking water, the bacteria pass in also and find their way into the body of another person who drinks the water. This person in his turn gets the disease, and thus the disease is spread. It does not necessarily follow that every person who drinks the water catches the disease, for some people, through being in good health or owing to some individual peculiarity not well understood, are able to resist the infection. Cholera, typhoid fever, and probably diphtheria also, are communicated from one person to another in this way. We will give a typical example.—A solitary house stands on the bank of a river from which the inhabitants of a village lower down the stream get their supply of water. A person living in this house gets typhoid fever. The drainage of this house, and with it the germs of the disease, soaks into or is poured into the river and soon the people in the village lower down the stream get typhoid fever.

Now that we understand the danger of using water, contaminated by sewage, for drinking purposes, we do not wonder that chemists have devoted much time and attention to finding a simple test which will at once show the presence of sewage matter. Unfortunately however no one simple test can be found, and we have to trust more to actual proof that sewage matter has passed into the water than to tests for its presence. There are however certain signs by means of which we can judge fairly well as to the fitness of a water for drinking purposes, and these we will now consider.

Collect a considerable quantity of the water to be tested in a clean vessel. (1) **Clearness.**—Put some of it into a clear glass vessel and hold it against a dark-coloured surface in a

good light. Any particles of dust, &c., floating about in the water can then be seen. These can of course be removed by filtration.

(2) **Colour.**—This can best be seen by pouring it into a tall glass jar, standing this on a sheet of white paper and looking down through it. If organic matter is present the water has a bluish or yellowish tinge. Clay and peat impart a brownish tinge. Pure water has a clear blue colour when a considerable thickness is looked through. Water with a slight colour is not necessarily unwholesome, but should not be used if a better supply can be obtained.

(3) **Smell.**—Pour some of the water into a flask and shake it well. If the smell is unpleasant the water is not fit to drink. If there is no smell, heat the flask and shake again, and if there is still no smell the water should be allowed to stand all night and shaken and smelt again in the morning. Any unpleasant smell under these conditions shows that the water is unfit for drinking. Absence of smell, however, does not prove that the water is fit for drinking.

(4) **Taste.**—If the water has an unpleasant taste people will not use it for drinking purposes if any other is procurable. Many waters however which contain a large amount of organic impurity have no unpleasant taste.

(5) The tests just described will afford some indication of the purity of the water tested, and unpleasant taste and smell will be quite sufficient to condemn the water for drinking purposes; but the absence of colour, taste, and smell, does not prove the absence of dangerous impurities. A water containing organic matter in solution may be bright, sparkling, and clear, and have no taste or smell; so we require a further test for organic matter. The test is as follows.—Fill a clean white teacup with the water to be tested and add to it a few drops of diluted sulphuric acid and some Condy's fluid (permanganate of potash solution) till the water is rose-coloured, cover over and allow it to stand. If the water be impure it

will lose its colour in a few minutes, and if more Condy's fluid is poured in, it too will lose its colour until a considerable amount has been added. The only objection to this test is that iron and peaty matter will give a similar result, but if these are known to be absent this test is a pretty sure indication of the presence of organic matter, especially when taken in combination with other tests.

(6) **Residue.**—Something can be learnt about the quality of water by studying **the residue** which is left when a quantity of water is boiled away (perfectly pure water would leave no residue). If the residue be large in amount it probably shows that a considerable amount of mineral matter is present and that the water is hard. If the dry residue, when heated nearly to redness, blackens (from being converted into carbon), this shows the presence of organic matter.

(7) **Ammonia.**—The **presence of ammonia** in water is suspicious, and almost certainly points to sewage contamination.

(8) **Nitrites and Nitrates.**—These, if found in a deep well water, may be derived from the chalk through which the water passes, and their presence does not prove that the water is contaminated with sewage matter. In shallow well water, however, their presence is suspicious, though not a conclusive proof, of contamination. Suppose, for instance, a river receives a certain amount of sewage matter, which sewage matter gets oxidised by the running water as has been already explained; the products of oxidation will be nitrites and nitrates, and if the water be tested at some point considerably lower down in its course, nitrites and nitrates will be found, though the water may be quite pure and wholesome. Still their presence shows that there has been sewage contamination, which may be still going on.

(9) **Chlorides.**—Unless the water has flowed over rocks containing salt or is taken from near the sea, the presence of chlorides shows that the water has been contaminated by

sewage, though whether the sewage matter is now oxidised and therefore harmless, or is still in a fresh and active condition, is not shown.

We can now give the characteristics of a good drinking water. It should have no colour nor turbidity, taste nor smell. It should contain no organic matter—vegetable or animal—as shown by the absence of any appreciable amount of chlorides, nitrites, nitrates and ammonia, by the residue remaining white when heated, by Condy's fluid keeping its colour when added to it. It should not contain any metallic impurity nor a very large amount of mineral matter. It is not often possible to get a water which fulfils all these conditions, but all are not equally necessary. Thus we should not altogether condemn a water for drinking purposes because it contained a little vegetable matter, especially peaty matter, nor because it was very hard, nor because it contained a little iron; though we should not use such water if purer were procurable. The impurities to be avoided are sewage matter and lead. Of course we must know the source of the water before we can be sure whether the chlorides, nitrites and nitrates are of animal origin.

We have learnt a little about the sources of water and must now consider how the water is supplied to our houses and how to keep it from being contaminated on its way to our houses.

Country houses standing alone and small villages generally get their water supply as best they can from wells, springs, rivers or streams. Wells and springs should be built round with bricks or cement, or in some way rendered impervious, so that sewage matter from neighbouring cesspools may not be able to soak through; and the border of this lining should be raised above the surrounding soil so as to prevent any water that may be lying about from getting in, and to prevent mud being washed in by heavy rain. The well should also be covered in to protect from dust, but not so closely as to exclude all air.

When any number of people are living together in a town,

it becomes necessary to have a regular water supply, which is often difficult to obtain. The deep wells in the neighbourhood are used as much as possible, but besides this it is generally necessary to get additional water from rivers, lakes and streams. The water is collected into reservoirs, where the impurities that may be floating in the water are allowed to settle or, if necessary, are filtered off by passing the water through beds of sand or gravel. The water now passes from the reservoir by means of cast-iron pipes jointed together, into the **water-mains,** and thence by service pipes into the various houses. The service pipes are generally of lead, because this material can be bent so readily. If the water is hard, there is little danger in the use of lead pipes, if the water which has been standing in the pipes all night is allowed to run away; but soft water dissolves a good deal of lead, and the pipes for conveying soft water should always be coated with pitch or tar, or be made of iron in place of lead.

The water from the reservoir may be allowed to run into the service pipes continually, and this is called the **constant supply system,** or it may be allowed to run for a certain time and then be turned off by means of a stop cock (or tap). This is called the **intermittent supply system.** In the latter case each house has a cistern large enough to hold the supply of water for a day. (This should be at least 10 gallons a day for each individual.) When the cisterns have been filled the water is turned off.

The constant system is by far the better of the two, but the objection to its use is that there is great waste if the pipes leak or if taps are left turned on from carelessness.

The intermittent system necessitates the use of a cistern, and the water is liable to get impure in several ways. (1) Dust and dirt may get into the cistern, or even dead animals and birds, especially starlings. (2) Sewer gas may find its way into the water by a waste pipe. (3) Cisterns require periodical cleaning out, and this may be neglected. (4) The water may

dissolve out some impurity from the material of which the cistern is made, *e.g.*, lead.

If, however, the use of a cistern for the supply of drinking water cannot be avoided, the following points should be attended to. (1) Cisterns should not be made of lead unless coated with tar or pitch, but of slate slabs set in cement, or of cast iron. (2) Cisterns should be covered over to keep out dust, but not so as to exclude all air, and they should be protected from heat and frost. (3) The waste pipe should not pass directly into a drain or sewer lest when it is empty the sewer gas should pass up it and get into the water, but the waste pipe should end above ground over a trapped and ventilated grating. The water from a cistern should not be used to flush a water closet lest the sewer gases pass up the pipe when it is empty. A separate cistern should be provided for the purpose.

Water mains should be laid down as far as possible from gas pipes and drains and sewers, lest gas, or even liquid, get into the water from these sources.

It is often not possible to obtain a pure supply of water for a town, and the water is liable to take up further impurities in the course of its distribution and storage, so that some method of purification becomes necessary. This purification is effected by filtering.

We have seen that water is generally filtered before it is sent out from the reservoir. The sand and gravel used for this purpose act as a strainer and to remove anything floating in the water, but whether any of the dissolved organic matter is oxidised and so rendered harmless is uncertain. In any case it is safer to filter the water immediately before using.

Animal charcoal and spongy iron are the materials most used in filters. Both are very porous, like a sponge, and contain a great deal of compressed air in their interstices. This air oxidises and renders harmless any organic matter that may be in the water (unless the organic matter be

present in large amount). Charcoal, and spongy iron also, removes salts, such as sodium chloride and calcium carbonate, thus rendering the water less hard. They of course remove also impurities floating about in the water; but this is generally done by passing the water through sand, gravel, or sandstone, before it reaches the charcoal. Both animal charcoal and spongy iron require to be renewed or cleansed frequently (at least once a year). If this is not attended to they get clogged up and give impurities to the water instead of removing them.

The best way to clean a filter is to take it to pieces, and either put in fresh material, or boil the old material in water, and then expose to the air till dry. If it cannot be taken to pieces, some Condy's fluid should be run through, and then plenty of pure water till all the Condy's fluid is washed out.

Hardness in water is not so much an objection for drinking, as for washing and general cleaning purposes. Water is softened on a small scale by the use of soda, soap, and washing-powders, and for making tea and boiling vegetables by the use of bi-carbonate of soda; on a large scale it can be softened by Clark's process. The water is mixed with lime water in a tank and allowed to settle. The lime water combines with the carbonic acid gas present in hard water, forming with it calcium carbonate, which sinks to the bottom, as does also the original calcium carbonate held in solution by the carbonic acid gas which is now removed. This removes the temporary but not the permanent hardness. In this way the hardness of the water at Canterbury is reduced from 23½ to 8½ grains per gallon, thus effecting a great saving in soap and tea.

Beverages.—Beverages include tea, coffee, cocoa, aërated drinks, such as soda water, mineral waters; effervescing drinks, as ginger beer, lemonade, fruit juices; cocoa is the only one that has any nutritive value.

Tea and coffee both contain a volatile oil and an alkaloid which is called Theine in tea, Caffeine in coffee. The alkaloid is a

substance something like quinine, only not so bitter. It is this alkaloid which makes these beverages so refreshing and stimulating, so that they lessen fatigue and produce wakefulness. Tea contains 3 or 4 times as much of this alkaloid as coffee and cocoa, and this explains why it is preferred as a refreshing beverage in the afternoon.

Tea and coffee are alike in containing a volatile oil and an alkaloid. (Volatile oils such as oil of cloves, oil of peppermint, &c., are chemically not oils at all but are called so from their resemblance to ordinary oils. They differ, however, in their composition and mode of preparation.)

Tea.—The alkaloid theine is soluble in hot water, and the flavour and aroma of the volatile oil is best brought out by water that is quite boiling. To have the water quite boiling when it reaches the tea, it is necessary that the teapot should be hot to begin with. We therefore rinse it out with boiling water before putting in the tea. There is no advantage in pouring a little water on to the tea first, letting it draw and then filling up the pot, but the pot should be filled at once with the required amount of water. The pot should then be kept as hot as possible for five or ten minutes until the tea has 'drawn,' and the tea should then be poured out at once. If left to stand, more and more of a substance called tannin is dissolved out giving the bitter astringent taste well known in tea that has stood a long time. Tannin is got from oak galls and is used in tanning leather. It has a similar effect on the coats of the stomach, and on any meat fibre which may be in the stomach. We can therefore understand the injurious effects of drinking tea that has stood for some time. Even freshly made tea contains a little tannin, so that tea should not be taken with meat as it hardens the fibre and renders it difficult for the digestive juices to act on it.

If tea has to stand long it is better to pour it into another pot (previously heated) as soon as it is drawn, or to put the tea into a wire cage or muslin bag with a string to it and to draw

this cage or bag out of the liquid when the tea is sufficiently drawn.

Coffee.—Coffee, obtained from the fruit or seeds of an evergreen shrub, contains the same alkaloid as tea (called in this case caffeine), which gives it its refreshing power and essential oils giving aroma and flavour but contains no tannin, and therefore has not the disadvantages of tea as an after-dinner drink.

To get good coffee the berries should be roasted and ground just before use, for thus the aroma is retained. A good arrangement for making coffee is to have one cylindrical vessel fitting inside another, the inner one half as deep as the outer and provided with a grating or strainer below. The coffee is put into the inner cylinder, boiling water is poured over, and the clear liquid strains through into the outer. In this way also the coffee is brought into contact with the hotter water which is always at the top. Hot milk added to coffee much improves its flavour.

Cocoa.—This is obtained from the seeds (nibs) of a plant. Like tea and coffee, cocoa contains an alkaloid and a volatile oil, but also a considerable amount of fat often removed in prepared cocoa and replaced by starch or sugar. It also contains some proteid. It is not so refreshing as tea and coffee, but contains a considerable amount of nourishment and is very suitable for children. Some people find it indigestible.

Non-alcoholic beverages other than these are chiefly used to quench thirst. They contain a small amount of salts or organic acids; thus lemonade from lemons contains citric acid, fruit juices, tartaric, and malic acid.

Effervescing drinks such as soda water, ginger beer, lemonade, &c., are made by pumping carbonic acid gas under pressure into water.

Alcoholic beverages.—These all agree in containing alcohol to a greater or less amount.

Beer contains three to five per cent. of alcohol and some

bitter principle derived from the hops. The hop bitter has a stimulating effect on the appetite and aids digestion. Beer, but more especially porter, also contains sugar in a form which is easily digested.

Wine contains 8 to 14 per cent of alcohol—the quantity varying with the kind of wine—some sugar, some cream of tartar and some malic acid.

Spirits.—These include brandy, whiskey, rum, gin, and contain 40 to 50 per cent of alcohol. The difference between these depends on a small quantity of flavouring substance which they contain. Thus gin is flavoured with juniper.

Alcohol, like carbo-hydrate, consists of carbon, hydrogen, and oxygen, and appears to have (when taken in small quantity) a like power of being oxidised in the body so as to give out heat, and also of uniting with proteid to form tissue. It is not one of the class of essential foods, viz., proteids, for it contains no nitrogen. When taken in large quantity a small amount only is converted into tissue, &c., and the rest passes out of the body unchanged. It is thought by some that alcohol does not form tissue itself, but prevents the waste of the tissues by being oxidised in their stead, so that in diseases like fever where little food is taken and the tissues are rapidly wasting, it appears to be useful, but should of course be given like any other medicine under the doctor's orders.

A moderate amount of beer, porter, or wine, taken with a meal either before, or after, or during the course of it, stimulates the flow of gastric juice and saliva, so aiding digestion, sharpening appetite, and giving a relish to food. If taken in large amount, with or after food, or strong in the form of spirits, it hinders digestion by rendering the food, especially proteids, tough, and, by acting on the walls of the stomach, prevents the secretion of the gastric juice. Hence the inability to eat and digest food characteristic of a drunkard.

Alcohol makes the heart beat more quickly and forcibly, and so is useful in failure of the heart's action as in fainting,

drowning, severe bleeding. It acts on the capillaries under the skin in such a way as to open them more widely, so that more blood passes through them; hence the flushing and sense of increased warmth which follow the taking of alcohol. As a matter of fact the temperature of the body is lowered, not raised, because the free flow of blood under the skin allows evaporation to go on more easily, and this evaporation cools the body. We therefore take alcohol if we want to perspire, as when suffering from a feverish cold, when the skin is hot and dry, but we should not take it before going out on a cold winter's night, as then we want to keep in the heat of the body as much as possible. Arctic explorers have found themselves better without it.

When taken in large amount or in a pure form (as absolute alcohol), alcohol is a **poison,** and causes depression both of mind and body, and ultimately death. People get accustomed to the use of alcohol, so that in time amounts can be taken without much effect which would be fatal to one unaccustomed to them. The same thing is true of opium and other poisons. Children are easily poisoned by alcohol. Every year we read of cases of children killed by their mothers in this way.

We see then that alcohol is useful as a medicine and in certain cases as a food; but it must be clearly understood that it is quite unnecessary in health, and especially for young people. The danger in its moderate use lies in the fact that a craving for it may be set up, requiring larger and larger doses to satisfy it, until a habit of habitual heavy drinking is formed. On this account it is better to avoid it entirely except in cases of necessity. Experiments have been tried to see whether a healthy man can do more work when taking alcohol than when not taking it. It is found that he can do more work with less fatigue without it.

CHAPTER VII.

REMOVAL OF DIRT.

Waste matter escapes from the body by the skin, lungs, and kidneys. The lungs give out daily carbonic acid gas—29 ozs.—and water—9 ozs.—together with highly decomposable organic matter. The skin gives off double as much water as the lungs but only about $\frac{1}{40}$th as much carbonic acid gas and a small quantity of salts in solution. The special organs which do this work of excreting water are called sweat glands.

Some animals, like the frog, have very thin skins through which the water easily escapes by evaporation, just as water would escape from a basin covered by a cloth. The water escapes chiefly from the blood which runs just under the skin. Our skin is much thicker than the frog's, the blood capillaries are situated in the dermis and covered by the epidermis which is thick, being composed of many layers of cells, so that very little water can get through the skin, and special organs—sweat glands—are necessary. The sweat glands are tiny tubes about $\frac{1}{300}$th of an inch in diameter, opening on to the surface of the skin. They run down through the epidermis or scarf skin to the dermis or true skin where the nerves and blood vessels are. Here the tube forms a coil surrounded by a network of blood capillaries. The inside of the tube, like the air-sac of the lungs, is only separated from the blood in the capillaries by its own very thin walls and those of the capillaries; consequently moisture and carbonic acid gas can easily escape from the blood into the tube and so into the external air. A certain amount of oxygen is taken from the air, in the tubes, into the blood, in exchange for the carbonic acid gas given up, *i.e.*, a

certain amount of respiration goes on through the skin. In man this is not so important, but in some animals—the frog—a great deal of its breathing is done by the skin, and a frog will live some time after its lungs are destroyed, but will die unless its skin be kept moist so that evaporation can take place through it. The sweat consists of water, saline matters, decomposable organic matter, and some oily matter. Besides this another set of glands called sebaceous, which secrete an oily matter at the bases of the hair, mix their excretion with that of the sweat glands and make the sweat still more oily. In addition the sweat gets mixed with the scales that are always falling, or being rubbed, off the skin.

We can prove that the skin changes the air in something the same way as the lungs do by shutting up a man's arm in an air-tight gutta-percha bag. If we examine the air after a time we shall find that it has gained carbonic acid gas and water, which condenses on the side of the bag, and has lost oxygen. The water escapes, as a rule, as vapour which we do not see and which does not make the skin wet, but in very hot weather or after violent exercise the sweat is so increased in amount as to appear in drops on the skin as 'sensible perspiration.'

If the sweat is not removed from the skin it speedily undergoes decomposition, like all excretions from the body, and becomes offensive. Dust from the air and from surrounding objects, particles of clothing, &c., get mixed with it and form altogether what we call dirt. If this dirt is suffered to accumulate, parasites of various kinds, spores of fungi, and small animalculæ called bacteria, find in it a fine soil in which to grow and multiply, and various diseases result.

If this excretion is not removed from the skin it stops up the tubes of the sweat glands and prevents further excretion. The kidneys and the skin share the work of excreting water between them, so that when the skin does not act extra work is thrown on the kidneys, and *vice versâ*, and the overworked organ may get diseased.

We now understand the double need of removing this excretion as speedily as possible, and must consider how it can best be done. Simple water is not sufficient for the removal of this oily excretion; soap must be added to dissolve the oil. Warm water is useful in removing the sweat, but need not be used daily; a wash all over with warm water once a week is sufficient for cleanliness, but cold should be used daily. A bath in which the whole body can be immersed is a luxury, but the body can be washed clean with a bucketful of water, and this should be done frequently—every day is not too often. A cold bath acts as a splendid tonic to those whom it suits, but cannot be taken by all. Soft water has many advantages over hard for washing purposes; it saves soap and has greater cleansing powers.

A few words about soap. The requisites of a good toilet soap are, that it should contain no free acid or alkali, nor any substance which can irritate the skin, and should form a good lather with cold water. Highly scented and coloured soaps should be avoided, as they often contain injurious substances. Pears' soap and Sanitas can be recommended for toilet purposes. Soft soap contains an excess of potash and is useful for house-cleaning purposes, but should not be used for the skin.

The clothes we wear need washing as well as our skin. The clothes we wear next the skin absorb the perspiration from it. If clothes are worn too long without washing they become saturated with perspiration and refuse to soak up any more. This is a disadvantage, for, as we have learnt, the function of clothes is to soak up the perspiration. Besides this, if the clothes are not washed, the substances they have absorbed begin to decompose, and aid the dirt on the skin in forming a resting place for parasites, &c. The clothing worn next the skin should be changed once a week, and dirty clothes should not be allowed to accumulate for several weeks, as is often done, but should be washed every week. A few words as to

how washing should be done may not be out of place here. Calico and linen articles should be wrung out from cold water, laid out on a table and well soaped, then put into a tub, hot water poured over them and left to stand over night or longer. They should receive one rubbing in this water, then be transferred to fresh hot suds and be well rubbed till the dirt is removed. They should then be boiled in a copper with suds, taken out, rinsed through several waters, wrung out and hung out to dry. Washing powder or soda, or both, should be used to soften hard water. Coloured articles should not be soaked nor boiled, nor should soda or washing powder be used. Flannels and woollen articles should not be soaked nor washed with soda nor boiled, for they will shrink, but should be washed with soap in moderately hot water, rinsed in warm water once or twice, and hung out to dry as quickly as possible.

Houses also require cleaning. The dirt in them consists of 'fluff' from clothing, particles worn off from the floor, ceiling, furniture, &c., smuts and ashes in winter time, dust and smuts blowing in from outside, hairs, feathers, crumbs, scales from the skin. Some of this dirt settles on the floor and furniture, and can be removed by sweeping and dusting, some settles on the walls and ceiling, so that they also require frequent sweeping and rubbing and periodical painting, whitewashing, or papering. If this dirt be suffered to accumulate in rooms, it gives them a stuffy, unpleasant smell, affords a breeding ground for fleas, fungi and bacteria, and is liable to get stirred up and diffused through the air when a window is opened or any furniture moved. The organic part of the dirt undergoes decomposition in time, and has, in a less degree, effects like those of sewer gas. Sweeping alone is not sufficient to remove dirt from rooms, but must be supplemented by washing. Floors, however, should not be washed in very damp weather, unless they can be quickly dried by artificial heat, and people should not use them till the

floor is dry. The damp rising from floors is injurious, and may give rise to colds and rheumatism.

Furniture should have as plain and smooth a surface as possible. There should be no corners and crevices from which the dust cannot be dislodged. A smooth surface which is not injured by washing is the best. Walls, too, should have a smooth surface, from which the dust can be easily wiped. There should be no projecting cornices near the ceiling on which dust can accumulate. Cupboards and wardrobes should either reach to the ceiling, or have smooth tops. All unnecessary furniture should be dispensed with, as it absorbs some of the all too small air-space which each person can get. Carpets, rugs, curtains and draperies should be frequently brushed and shaken. Floors that are not carpeted should be stained and varnished or covered with linoleum, as plain wood has great power of absorbing organic matters. Rubbish should not be allowed to accumulate in cupboards, &c., and never under beds. Beds should be made of iron rather than wood, and are better not covered in above.

All refuse matter should be burnt or removed from the neighbourhood of a house as rapidly as possible. Dust, tea-leaves, potato-peelings, uneaten food, &c., should be dried and then burnt, unless there is some other way of rapidly removing them from the house. Such things should not be thrown into an ash-pit, unless it is emptied every day, because they will decompose and make a bad smell.

Sewage matter in towns is generally removed by the water system, which if properly carried out gets the sewage matter away from the houses as soon as possible. The difficulty is to know what to do with this highly diluted sewage. This has been partly overcome by making sewage farms, on to which the sewage can be run and used to fertilise the land. This, if properly managed, is the best way of disposing of sewage matter, but we cannot go into the question here. In country places a dry system, in which the sewage is deodorized by fresh

earth or ashes and distributed over the land, is the best. Cesspools are always dangerous, for they poison the air in the neighbourhood of the house. If they have to be tolerated they should be at some distance from the house and from the water supply, should be lined by some water-tight material, covered in, and well ventilated. The same remarks apply to ash-pits, which should be above ground, not below.

Parasites.—As we have already said, parasites may be introduced by means of improperly cooked food and impure water. Food must therefore be carefully cleaned and examined before cooking, and be thoroughly cooked, when all danger from this source is removed. Water should of course be perfectly pure, but if this is impossible, it should always be boiled.

Parasites in the Skin and Hair.—Thorough cleanliness is the greatest enemy of these parasites, but of course there is always the danger of getting them from others. The most common are:—

Ringworm.—This is due to a fungus which gets beneath the skin, and generally occurs in ring-like patches: hence its name. It is mostly confined to children, and care should be taken that the infected child should not come into contact with other children, and should not use the same towel or brush. Wash well with soft soap and warm water, and then paint with tincture of iodine or mercury ointment. The child should be kept thoroughly clean.

Scabies or Itch.—This disease is caused by a very small insect which bores beneath the skin. It is easily caught by other people coming in contact with the infected person. The skin should be washed all over every day with soap and warm water, and sulphur ointment rubbed in. All clothing worn or used by the infected person should be boiled when being washed, and should be kept separate from other clothing, for the insect is easily transferred from one person to another by the clothing.

Pediculi or Lice are little insects that get just under the skin on the head. Their eggs (nits) get attached to the hair. Various substances are used for killing the lice; petroleum is useful, or mercury ointment, or carbolic acid. To get rid of the nits the hair should be well washed with borax or soda, and the hair, in the case of children at least, should be cut short.

House Parasites.—The only efficient way of getting rid of these is by fumigating the house or room. All the cracks and crevices in the doors and windows should be carefully stopped, as well as the chimney, and then sulphur should be burnt. A pound of sulphur should be burnt for every 1000 cubic feet of air-space. The sulphur should be placed on some old dish that will not crack, to prevent its setting fire to the floor. After the sulphur has burnt for three or four hours, the doors and windows should be opened widely, and a thorough current of air be allowed to pass through for twenty-four to thirty-six hours. Thorough cleanliness and ventilation are the best preventatives of these parasites. Iron bedsteads are better than wooden ones, because the parasites sometimes get inside the woodwork and are difficult to dislodge.

CHAPTER VIII.

HOUSES, AND WHERE TO BUILD THEM.

We require houses to shelter us from rain, snow, and wind, and from heat and cold. We must now study how to make them as healthy as possible. We will begin by considering of what material they should be made.

Material.—The materials of which houses are built are very various, *e.g.*, stone, brick, wood, mud. Brick houses are preferable to stone because they are more porous, and allow air to pass through them more easily. Wood has the disadvantage of readily catching fire. Roofs are made of slate, tiles, thatch, and galvanised iron. Thatch is a non-conductor of heat, and keeps the house warmer in winter and cooler in summer than either slates or tiles. It is, however, liable to catch fire, and to be carried away by the wind.

Foundation.—A house should not be built on refuse containing animal and vegetable matter or road scrapings, because these will rot and give off noxious gases, which will enter the house. The subsoil should be covered with a layer of concrete, to prevent damp and gases rising from the subsoil. The ground contains a great deal of air and other gases, which may be very injurious if the ground is impregnated with sewage, or if there is decomposing animal or vegetable matter in the neighbourhood. Walls should stand on a damp-proof course of slates, set in cement to prevent the moisture from the subsoil from rising into them.

Another way of preventing ground damp, and also driving rain from getting through the walls, is to make them double, with an air-space between the inner and outer walls. This

makes a house much warmer, too, for air is, as we have seen, a good non-conductor. Driving rain may also be kept out by covering the exposed side with slates

Arrangement of Waste Pipes and Drains.—Sinks, baths, lavatories, and water closets should, if possible, be placed

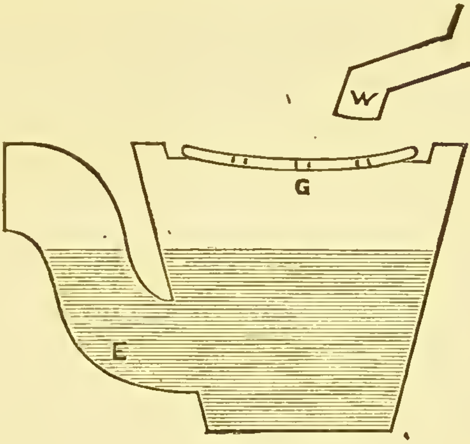

Fig. 97.

against the outside wall, so that their waste pipes may pass outside directly, and not through the house. No waste pipe should open directly into a drain or sewer. A trap should

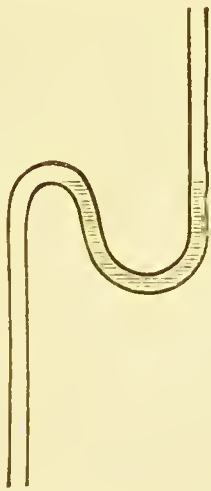

Fig. 98.

intervene. Waste pipes that convey water only should open over a grating connected with a trap. Traps are of several kinds, but the principle of them all is that by a bend in the pipe some water is interposed between the waste pipe and the sewer, which water acts as a plug to prevent the sewer gas running up the waste pipe (see fig. 98). Traps are of little use unless the drains on either side of them are well ventilated. In the case of drains passing under houses, this can be effected thus. From the end of the drain away from the main sewer a pipe is carried all up the side of the house, opening to the external air above the level of the roof. At the place where the house drain enters the main sewer there is a ventilated trap. By these means a current of air can pass along the house drain, preventing an accumulation of sewer gas under the house. The great danger of allowing sewer gas to accumulate under a house is that when the air in the rooms gets warm, fresh air rushes in from outside or from under the house if it can get, hence the importance of covering the sub-soil with concrete, and of making the part of the drain under the house air tight, while providing for a free flow of air through it.

Light.—Houses should have plenty of entrances for light. It is a great advantage if a room has two windows facing each other, for then cross ventilation can be carried out. Light is as necessary to people as to plants. People living in cellars and dark places are pale and sickly. Artificial lighting is generally produced by means of candles, lamps, gas, or electricity. Electricity has many advantages over other forms of lighting. Incandescent lamps are usually employed for houses. The lighting portion being enclosed in a vacuum, no oxidation takes place, and hence no products of combustion are formed. Less heat is produced than by gas, and there is no possibility of setting anything on fire. The light given out is stronger, and is a nearer approach to daylight than gas or lamps. The cost is, however, somewhat greater than that of gas.

Lamps give a softer light than gas, and the products of com-

bustion are not so injurious as those of gas, but gas is more convenient and safer.

Position and Surroundings.—A house should stand on a slope, but not at the bottom, where it receives all the drainage from above it. It should stand some way up the slope so that the drainage may run away from it. Trees are very useful, but should be at some distance from the house so as not to interfere with the free circulation of air round it, and to avoid having decaying leaves close around it. If built on the side of a steep hill, care should be taken to leave a sufficient space between the house and the hill, or else the house will be damp and dark, and free circulation of air round it will be prevented. Care must, however, be taken that surface water from the hill above does not accumulate in the space behind the house. A house should face E. or W. or N. E. and S. W., so that the sun may shine on both front and back during some part of the day, and should, if possible, be protected from N. and E. winds by the rising ground above it, or by clumps of trees. There should be no hollows filled with water near a house, nor animal nor vegetable refuse, nor marshes. Districts where fogs rise at night should be avoided if possible.

Streets.—These should be open at both ends so that a free current of air may flow through them. Courts and alleys that are blind, *i.e.*, with only one opening, are objectionable.

Soils.—Soils may be divided into two classes—(1) Those that are permeable by water, chalk, sand, and sandstone; (2) Those that are impermeable, as clay, marl, granite, limestone. The former allow the rain that falls on them to pass away easily, and are hence called dry soils. The latter do not, and are called wet soils. It is not always possible to choose the soil on which to build a house, but if there is a choice, preference should always be given to a porous soil.

Of the rain that falls on the soil, some sinks through it to greater or less depths, and is called the ground or subsoil water. Its depth below the surface depends chiefly on the permeability

of the sub-soil, and the relative height of the land. In a sandstone district, for instance, or a chalk district, the water will be a long way below the surface, as is shown by the deep wells that have to be made in chalk or sandstone. When there is not free outlet for the water, the level will be near the surface, whether the soil be permeable or not, as in low-lying districts, or in valleys shut in by mountains. In any case where the subsoil water is near the surface, some system of drainage must be devised to make the level lower, or the district will be unhealthy.

Drainage.—In the country the drainage of the subsoil is carried out by a system of pipes or water-ways built of brick, which convey the water to the nearest stream or river. If these pipes are simply to convey the subsoil water, and there is no danger of sewage matter getting into them, they are better not water-tight, because then water can find its way into them at all points. The ground water beneath a house should always be at least three feet below the foundation. A damp soil makes the air cold and misty, and tends to produce colds and rheumatism; besides this, water hinders the oxidation of organic matter in the soil, and fever and ague result. The Fen district in England, in which fever and ague were formerly very prevalent, has been rendered quite healthy by drainage.

In towns there must be drains for carrying away sewage matter, waste water, and surface water from the roads as well as sub-soil water. Sometimes there is one set of sewers to serve all these purposes. In other cases the sewage is carried by one set of pipes, the surface water by another. This plan is generally adopted when the sewage is to be used for the purpose of fertilising land, and too great an excess of water is undesirable. The surface water, &c., is then carried to the nearest water course, but the objection is that it is often very impure and pollutes the river. Sewers must not be porous like drains, because of the great danger of pollution of wells and of the soil. They must be quite water-tight, so that they can be

flushed at intervals. By flushing, we mean cleaning out a sewer by sending a rapid stream of water through it under pressure. Sewers should be water-tight, but not air-tight. Arrangements should be made for the thorough ventilation of sewers, either by an opening to the surface closed by a grating, or by a pipe carried up to the top of the house. The object of ventilation is to so dilute the sewer gas with air as to render it harmless. Of course it is much easier to carry out a system of drainage when the ground slopes naturally; indeed, a sloping, impervious soil is preferable to a flat, low-lying, porous one.

Climate.—In considering where to build our house we must take into account the climate of the country or district in which we propose to build it. Strong, healthy people can live and be healthy in most climates if they take reasonable precautions, but for delicate people the right choice of a climate is a very important matter. The causes which affect the climate of a place are:—

(1) The climate of any place depends on its distance from the equator; the greater the distance from the equator the colder the climate, other things being equal. Other things are not generally equal, however, and a place in England on the same parallel of latitude as one in Russia has a very different climate.

(2) The configuration of the surface, *i.e.*, whether the surface of the earth is flat or hilly, makes a great difference to the climate. The greater the elevation the colder does the climate become, as is seen by the perpetual snow which lies on the tops of high mountains. The slope of the hill or mountain that faces the equator is warmer than the opposite slope. More rain falls on mountains than on low lands. Low-lying land near the sea, rivers, or sheets of water, is liable to fogs, especially at night. The earth takes in heat from the sun during the day and warms the air above it. This air then gets saturated with moisture from the adjacent water. At night the earth cools

rapidly and cools the air above, which is not now able to hold so much water in the form of vapour; some of the vapour, therefore, condenses and forms a fog. Fogs rise in valleys and plains in the neighbourhood of mountains from a different cause. The mountain tops lose heat rapidly at night and cool the air over them. This cold air rolls down-hill and, meeting the warmer air of the valleys, cools it, causing the vapour which it (the warm air) contains to condense in the form of fog. Narrow valleys and ravines, and valleys closed at one end through which air cannot freely circulate, are unhealthy places to live in. For the same reason a house should not be built close against a steep hill.

(3) **Distance from the Sea.**—Places near the sea are cooler in summer and warmer in winter than other places, in the same latitude, farther distant from the sea. This difference is seen between inland places and places near the sea even in this country, and still more clearly in the difference between the Eastern and Western provinces of Germany and between Russia and England. Both land and sea take in heat during the summer, but the land takes it in more quickly and parts with it more quickly; so that the sea is cooler than the land in summer and warmer in winter. The sea, then, cools the land in summer and warms it in winter, rendering the climate more equable. By day the land is warmer than the sea and we get a cool sea-breeze blowing in, while at night the land is the cooler and a cool land-breeze blows out to sea. Climate depends, too, on the warm or cold ocean currents which pass its shores. Ireland is warmed by the Gulf Stream, while Newfoundland is cooled and fogs are produced by the cold current that passes it.

(4) **Winds.**—In our country the prevailing winds are westerly and generally bring warm moist weather, because they blow over the Atlantic. Northerly winds are cold but bracing. Easterly winds are cold, dry, and very unpleasant, and even injurious to many people. There is little high land in a direct

easterly direction from England over Russia and Asia, so the wind blows right across and gets cold and dry and, besides, picks up organic matter and even the germs of disease on its way, which possibly accounts for its injurious effects. In this country, then, a place which is protected by rising ground from northerly and easterly winds is warmer than one not so protected. In other countries the character of the prevailing wind largely determines the climate; but the subject is too large to be entered on here.

(5) **Forests.**—These, by hindering radiation from the earth's surface, make hot climates cooler. They also check evaporation, a useful quality in dry countries; but in some cases it is necessary to cut down forests in order to dry the land. Trees, in some way or other, increase the amount of heat. They tend to produce warmer nights, cooler days, by checking radiation and absorption.

(6) **Drainage.**—A system of deep drainage for damp land makes the climate warmer by doing away with the excessive evaporation which before took place, and causes it to be drier, and consequently healthier.

CHAPTER XI.

EXERCISE AND REST.

Whenever we move our muscles contract. By exercise we mean the systematic movement of some or all the muscles of the body. Perfect exercise provides for the contraction of all the principal muscles of the body in turn. When a muscle contracts, oxidation goes on more rapidly than usual, more oxygen is taken in, more carbonic acid gas, water vapour and heat are given out than when a muscle is at rest. The blood, as we have already learnt, acts as the carrier of oxygen to the muscles and other tissues and of carbonic acid gas away from them; consequently we should expect that it would flow more quickly and in greater volume than usual in order to get through its extra work. This is found to be the case. The heart beats more frequently (as we know from experience) and with greater force during exercise, sending an increased flow of blood to every part.

The lungs act in harmony with the blood, taking in more air than usual and giving out more carbonic acid. We breathe more frequently during exercise and take deeper breaths, to such an extent that five times as much air is taken in during exercise as during rest.

The skin acts more vigorously than usual and takes away the excess of moisture in the form of perspiration. The evaporation of this perspiration cools the body and prevents the temperature from rising too high.

Oxidation is always going on in the various tissues of the body during life, but goes on more vigorously than usual

during exercise, in something the same way as a locomotive engine burns more fuel when going at high speed. Any excess of carbonaceous food that may have been taken into the body is used up during exercise, instead of accumulating in the body in the form of fat.

It is a well-known physiological law that an organ of the body grows and becomes more powerful by exercise, and that an unused organ gradually wastes away and becomes powerless. This effect of exercise in hardening the muscles, making them larger and capable of greater and greater activity is well known, while the muscles of a bedridden person become soft and flabby, waste away and become powerless.

Digestion proceeds more rapidly and perfectly when sufficient exercise is taken. We should expect this result to follow from the increased flow of blood through every part. Violent exercise should not of course be indulged in immediately after a heavy meal, when all the powers of the body are engaged in the digestion of the food.

If exercise is to have a beneficial effect on our health, several points must be attended to.

(1) Clothing should not be tight, so as to impede the free action of the lungs. Of course if the clothing is tight all over the body no proper exercise at all can be taken. There should be nothing to interfere with the action of the skin, therefore the openings of the sweat glands should be kept free from obstruction by frequent washing, and the garments worn should be thin and porous.

(2) During exercise an increased amount of heat is produced by the body, but as soon as it is over the usual amount or even less is produced, while the body is still rapidly losing heat by evaporation. It is therefore necessary to put on an extra garment after exercise, to prevent the body taking a chill.

(3) Exercise is best taken in the open air, because so much more—even five times as much—fresh air than usual is required, and it is difficult to get this indoors. Rooms used for indoor exercise, such as gymnasia and dancing rooms, should be very well ventilated.

(4) Exercise should be of such a nature as to exercise all the muscles of the body at once or in succession. Base-ball and tennis are useful in this respect.

(5) More food is required when active exercise is taken, especially carbo-hydrate and fat.

(6) Exercise should never be taken in excess, lest disease of the heart or other organs result. By gradual training, people can accustom themselves to very severe exercise without injurious results, which a person unaccustomed to exercise would either be unable to perform or would be injured by, as is seen in the feats of running, swimming and walking performed by trained persons. Exercise should be taken regularly, not in fits and starts.

(7) Exercise should, if possible, be pleasurable. Of course this is not always possible when exercise is obtained in one's daily work; but all exercise undertaken by those engaged in sedentary occupations, and especially in brain work, should be of this character. The mind gets absorbed in the exercise, if pleasurable, to the exclusion of other thoughts and cares; the brain gets a thorough rest and goes back to its work with renewed energy. There seems to be no good foundation for the idea that athletics are incompatible with brain work. Of course, few people can excel in both; but a reasonable amount of exercise makes any one healthier and more able to do efficient brain work. This brings us to the subject of rest.

Rest.—Rest in a wide sense is change of occupation, including, therefore, exercise. Thus, when we have been sitting all day, a game or a walk is a rest; after hard bodily labour, to sit or lie down is a rest; after fatiguing the eyes by reading or sewing, they are rested by looking at distant objects. Every one, too, is refreshed by a complete change of air and scene, which is often taken by the sea-side, in the country, in travel or in a sea voyage. For brain-workers periodical cessation from brain-work and change of occupation are almost essential.

Sleep.—Besides this relative rest which is obtained by change of occupation, every one needs absolute rest or sleep. The amount of sleep required varies with the individual; but for an adult should not be more than nine or less than six hours. Children and infants should be allowed to sleep as much as they can. Indeed, infants should spend the greater part of their time in sleep.

Sleeplessness may be due to pain or anxiety, or may be without assignable cause. Sleeping medicines should not be taken without a doctor's order, because such a habit of taking them gets formed that it is impossible to sleep without them. Plenty of exercise during the day and a well-ventilated bedroom will aid sleep. A heavy meal should not be eaten just before retiring, because the various processes in the body do not go on so actively during sleep and the food is undigested; on the other hand, people should not go to bed hungry. A light meal should be taken just before bed-time. Excitement, especially at night, should be avoided by those who suffer from sleeplessness. Brain-workers should cease work at least half an hour before retiring, or sleep will not be refreshing. Feather beds keep in the heat of the body too much; mattresses are healthier. The covering should be warm but not heavy.

Habits.—If we do a thing at the same time every day, we

get into a habit of doing it more or less mechanically and with little effort. In this way the mind is left free for more important actions which are not habitual. Habits of taking meals regularly, of washing, of getting up and going to bed are important. A habit should also be formed of attending to the bowels at the same time every day, thus avoiding much inconvenience and discomfort. Constipation chiefly affects those engaged in sedentary occupations. Plenty of exercise, fresh fruit, and whole-meal bread are the best preventatives, and medicine should not be resorted to till other means have failed.

Section III.

PREPARATION OF FOOD FOR THE SICK.

By ALFRED CARPENTER, M.D., D.P.H.

Examiner to the Universities of London and Cambridge.

PREPARATION OF FOOD FOR THE SICK.

The care of the sick is becoming, as it should be, a scientific operation. Enquiries are made by those about to engage in the work as to the reasons why this or that food is to be preferred. We propose to consider the subject in its various aspects. There are several classes of food. How do these classes act upon the human constitution? How are they affected by the diseased condition of the recipient? and what is their comparative value?

These are some of the problems which have to be solved by those who direct the victualling department of the sick chamber, and who are responsible for its commissariat. It is a solution of these problems that we now undertake.

The Necessity of Food.—Why is it necessary to take food? It is one of those arrangements that have been made by the Supreme Being. Correlation of force is a fact in sickness as well as in health. Everything in nature is unstable, and is in a state of change from one condition to another. Movement is always taking place in all things. Different effects follow upon these movements. There may be a development of light or heat, of chemical or electric action. A consequence of that movement, and the accompanying disturbances, may be the vital force which is forthcoming wherever there are the required foci for its production. The microscopic germ upon which the development of organic matter depends appropriates to itself the material which happens to be in its close proximity, provided it is suitable, and temperature, moisture and air support the case; chemical action is established; some kind of magnetic force set free which reacts in its turn upon its surroundings; motion is produced, and a further supply of material is brought within reach of the growing

organism. This action is well seen in plant growth. It is visible in the cells of the developing seed or radicle at the extremity of the rootlet of a growing plant. It is also seen in the tip of the leaf-bud at the beginning of spring. By these means movement is begun, circulation is established, growth of tissue begins, and a demand is created for material to take the place of that which has been used up by cell growth. Here we have the primary explanation of the necessity for food, for every living thing in nature has its first commencement in a cell.

The Nature of Food.—All living matter requires food—the primary cell cannot begin its function without it; but it must be of the right kind. If it is insoluble, if it contains such elements as are not suitable to the growing matter, the latter is unable to appropriate it, or it is damaged in the act. It is starved in the one case or poisoned in the other, and another series of changes is set up, by means of which the vital force in the cell is deranged, diminished or destroyed.

Cell life can only appropriate material in solution, and which has been reduced to soluble salts if it be inorganic, or is in an albuminous or carbo-hydrated form if organic in its constituent elements. The ordinary constituents of the soil, such as chalk, silica, alumina, metals, with sulphur and its allies, must all be brought into a soluble form before they can be of any value to living organisms. These latter have an elective power by which they refuse the evil and choose the good. They even go further, and choose out the material which is more profitable to their growth, and leave that which is less so, or which is useless, to be removed by other agencies. In this elective power we have a means whereby we can affect the growth of tissue and regulate its development in a most direct manner. Gardeners now take advantage of this power as well as those who provide for the digestive organs of man.

The nature of food will be best understood in the first instance if we watch its effect upon vegetable cell growth.

The human body is unable to obtain its nutriment directly from the inorganic world. The inferior animals are no better off than we are ourselves. The vegetable world is the go-between, and is able by natural law to take up and appropriate inorganic matter after the latter has been dissolved in its proper vehicle by nature's work. Take, for instance, ordinary chalk, which must be provided for the growth of the skeleton. It is insoluble in water; it cannot be appropriated as such by growing cell life; but rain from the higher regions washes out the carbonic acid from the air, which is itself an impurity, the result of decomposition promoted by living tissues below; this material appropriates the carbonate of lime or chalk; a minute quantity of the bicarbonate is thus formed, and this new salt is soluble to a very small extent in water. This solution is capable of passing through the membrane which envelops the cell, and of being appropriated by the granules within the cell walls, upon which new cell growth depends. Deprive your cell of any solution of bi-carbonate of lime, and growth almost ceases, or is so modified as to set up a diseased state.

There is another element in cell growth, which is equally important, or even more so. A very minute quantity of phosphorous salt is also required. No cell growth can go on without these elements, although there may be abundance of other material. Carbon, nitrogen, and the elements which form water, viz., O and H, may be present, but there will be no satisfactory establishment of that movement which is the first requisite for the production of vital force unless Calcium and Phosphorus are present.

Some articles are more stable, that is, are less active, in their changes than others. The study of this property enables the scientific observer to provide more efficiently for the nourishment of the invalid or the proper development of the infant than is possible without it. Take, for instance, the two materials—sugar and starch. They are chemically very much alike in composition. Sugar disappears immediately it is put into

water ; but it is a long time before starch is acted upon, the granules of the latter remaining long after the former are lost to view. So, again, place a few grains of quinine sulphate in distilled water ; they are not altered in form, and remain visible to the naked eye ; but add to the water a drop or two of lemon juice and they immediately disappear, they dissolve in the acid solution.

The bearing of these powers in organic, as well as inorganic, matter must be considered if we would rightly understand the work we have to do. A strong and healthy digestion can deal with material in a different way from that which is necessary for the child, the invalid or the aged. The one may have at command the analogue to the drop of citric acid referred to above, and may thus be able to dissolve the quinine and present it in a form capable of assimilation ; the other may not have that acid at command, and the quinine passes away undissolved, and, as a consequence, unappropriated by the organism to which it is presented.

It will be out of our province to enter minutely into the classification of foods ; but it will be right to present a nominal list of their divisions, with general remarks upon their most excellent qualities. These may be placed under the head of alimentary principles. It is evident that unless the food chosen has in its constituent formula the particular aliment required, it will be useless and unable to effect the object for which it is administered.

The essential constituents of food, chemically considered, are all contained in the following list, placing them in the order of importance :—

1. Nitrogen, Carbon, Hydrogen, Oxygen.
2. Phosphorus, Sulphur.
3. Calcium, Potassium, Sodium, Chlorine, Magnesium.
4. Iron, Manganese, Copper.
5. Aluminum, Silicon, Fluorine.

The above list contains five divisions. It is formed more upon the principle of absolute quantity than quality. It may be that each is as necessary as the other, and that life would disappear from the face of the earth if any one of the list could be entirely removed from nature. Certain it is that if we carefully exclude all lime or iron or sodium from the food which we may supply to a given organism, we alter its nature and make an invalid of it in the first instance, and then allow conditions to be established which lead to its decease. Here then we have the foundation of our work, viz., to present to the invalid that form of food which he specially requires for his restoration to health, or for growth of new tissue.

Our next points for consideration are the classification in their different combinations of the elements mentioned, their physiological actions, their chemical relations, their capacity for assimilation by the healthy stomach, the effect which manipulation may have upon this assimilation, and their value as food stuffs when the healthy digestion has had to give place to a diseased state. Food of course includes drink.

They are classified by special writers into two principal divisions—

Nitrogenous and
Non-nitrogenous food.

The latter are further sub-divided into

Fats and
Carbo-hydrates.

To these must be added the inorganic materials, such as chloride of sodium, &c., which are more or less present in many articles of food. A brief survey of each of these classes will be all that can be presented to our readers, as space will not allow us to go further.

Nitrogenous foods are absolutely essential to the origin and continuance of life, and they must be supplied in a form capable of assimilation. Nitrogen is met with in all the tissues.

It might be concluded that as the air we breathe consists of four-fifths of the gas itself, it would be easily obtained from this source. But this is not so. Free nitrogen cannot be assimilated any more than silica or carbonate of lime. Organic nitrogenous material has to be supplied. This exists in various defined forms, recognised by the chemist and capable of being classified according to their feeding powers, the easiness with which they may be assimilated by the digestive organs, and the proportion of result which follows upon their use. The most important group consists of—

1. Albumen. 2. Fibrine. 3. Caseine.

They are sometimes styled Proteine compounds; proteine being regarded as the base of this class of alimentary principles. It is made manifest when the material under examination is subjected to the action of an alkali, the resulting compound being heated at the same time. Besides the three principles named, which are chemically the same in both the animal and vegetable kingdoms, there is another nitrogenous compound which does not yield proteine when so treated. This is *gelatine*, and its ally—*Chondrine*. They are obtainable only from animal products, and are not found in the vegetable kingdom. Gelatine is found in fibrous tissue and bony matter. Chondrine is only found in cartilage. It is the presence of these principles which accounts for the solidification of soups when they cool. It is not gelatine which causes the consolidation of vegetable juices, but a material containing C H and O only, and which is recognised by the name of *Pectine*.

The division of foods into nitrogenous and non-nitrogenous principles is a convenient one. Those foods which contain nitrogen are the foods which are necessary for the purpose of building up and maintaining the living tissues of the body, while the non-nitrogenous matter supplies the source of power corresponding to the steam and coal in starting a steam-engine, without which the engine would be useless. The machine is built up by material in which albumen, fibrine, caseine and

gelatine are essential elements. It is kept at work by the supply of *non-nitrogenous matter* in the shape of

1. Hydro-carbons or fats;
2. Carbo-hydrates or starch, sugar, and their allies;
3. Vegetable acids and alcohols.

The question now before us is the means whereby these agents are converted into building material on the one side or the analogue of steam power on the other.

Food, either cooked or uncooked, is conveyed into the stomach, and this organ has a duty to perform of a composite character. Its duty is assisted by various processes, some of which the sick person is unable to provide. The skill of the cook may then be of service. When nitrogenous food reaches the stomach it loses some of its characteristic properties; fibrine is destroyed, and will not again solidify after it has been acted upon by the secretions of the stomach; albumen, if coagulated, is re-dissolved, and is not capable of coagulation again; if uncoagulated, it is deprived of this principle altogether; caseine is solidified and then re-dissolved, and will not be precipitated, as it may be out of the body; gelatine is liquefied and will not again gelatinise. These changes are produced on nitrogenous matter by the gastric secretions. *Pepsine* is the peculiar agent, without which the required changes are not effected. The resulting compound has received various names, such as **Peptone** or **Albuminose.** Peptone has the following properties:—It is soluble in water to an equal degree, whether it is acid, alkaline or neutral; it is not precipitated by heat; absolute alcohol throws it down in an uncrystallizable state from its solution; it is uncoagulable, all but odourless and tasteless; it is excessively diffusible, and this property enables it to pass into the absorbents and the venous system of the stomach, conveying with it the water in which it is dissolved. Pepsine is necessary to effect the change, and pepsine is provided by the gastric glands, and cannot be obtained from any other source. There is also an acid secretion from the

same glands, though not peculiar to them. Chemically, it is a combination of hydrochloric and lactic acids. These together produce a digestive fluid, capable in health of providing building material as it is wanted. When any part of the machine is at fault its work may be assisted by art illuminated by the scientific knowledge which chemistry affords, and to this it is our duty to call attention.

The action of pepsine and the gastric acid on the nitrogenous principle produces a liquid to which the name of chyme is attached. It is joined by non-nitrogenous articles, it is assisted by the natural temperature of the body and the muscular movements of the stomach. The absence of, or interference with, these agents affects the result. That portion of nitrogenous matter not dissolved, and which may be in excess of the powers of the stomach to deal with it, passes out of the stomach through the lower orifice (the pylorus) into the duodenum, and thence into the intestines. Here it is still further acted upon by the secretion from the intestinal glands and the pancreatic juice. The chyme is distinctly acid, but in the small intestines it meets with alkaline fluids. Pancreatic juice is alkaline, as well as that from the intestinal glands. The bile also which it encounters in its passage is alkaline. The chyme then soon loses its acid reaction. These are important factors in regard to the assimilation of food. A solution which is acid in the stomach is neutralised by pancreatic and biliary secretions, and still further affected by intestinal glands, so that the undigested matters, as they pass away from the lower bowel, have been subjected to both agencies.

It is clear that anything which interferes with the production of pepsine, and gastric acid, bile, pancreatic juice, or intestinal secretion, interferes with the digestive power, and should be considered in ordering food for an invalid. It is essential to recollect that nitrogenous matter is necessary for the production of vital force, that it is unstable in itself. Life cannot continue without it. Upon its presence depend development,

growth, and renovation. Its chemical constituents are easily changed into simpler elements, and, when they have served their purpose in promoting vitality, some inapplicable material is left as excreta or débris, which must be rapidly removed. All secretions from glands also within the body require nitrogenous matter for the performance of their various functions. They become disturbed if it is not provided, or if they are embarassed by the presence of inappropriate material, while excess of supply and useless matter must be rapidly conveyed away. It is evident that whatever will make its appropriation more easy will assist in developing vital force, in increasing the activity of the body, its rapidity of growth, and the removal of used-up matter from the position in which it is left, and where, from its own instability, it becomes a danger to the organism if this removal does not take place.

All vital action appropriates something from somewhere else; there is also a necessary débris even if the quantity of matter available is the exact amount required. Renovation is most important, as, if the refuse is left *in situ*, there is disturbance and a depreciation of health, illness of some form or other, or diminished vitality, being the inevitable result.

We will consider the values of different kinds of nitrogenous foods presently. The chemical constituents are N H O C, with minute proportions of sulphur and phosphorus. These latter ingredients are not present in the next class, viz., fats, sugars, and alcohols.

The non-nitrogenous foods are required for the purpose of working the machine; they provide that which corresponds to the coal and water in the steam engine.

It is possible that nitrogenous food may provide some of this power; that an excessive quantity being provided, there is a tendency in the animal economy to lay by a portion in the form of fat. Normally, digestion being correct and quantity supplied being according to nature's demand, there should be no excess. The atom is broken up into an excretion, viz., urea, which is

carried off as effete matter by the kidneys ; it contains the nitrogen, and the residue consisting of C H O represents available power. If this be not used up at the moment of its formation it combines to form fatty matter. The fat thus produced is much in the way, unless the body is liable to suffer from an occasional want of supply, as happens to animals in the Arctic regions. They grow fat in summer, and that fat is used up in winter. In this case the supply of fat is laid down in safe quarters in out-of-the-way parts of the body. But it may happen that the excess does not appear in this form, but the elements remain as granular matter *in situ ;* we then have a so-called fatty degeneration established, and decay in vital power commences ; for the presence of this as a débris in the very centres of cell growth impedes their action and decreases their power of manifesting vital force. If in muscle, the cell fails to contract ; if in brain or nerve cell, the battery is affected, &c. Here then comes into the field of action the proportion of the dietary. If this is excessive it may cause the beginning of disease, and thus the blessing of food may, by indulgence, lead to an earlier decease.

Having shown that nitrogenous matter forms the machine, we will now look at the elements required to keep it moving and renew it when it is wearing out.

The formula discovered by Mr. Joule enables us to put a figure value upon the results of activity, by means of which we can weigh motion as against heat or light. He found that it required the same amount to raise 722 lbs. of material one foot high as, in the form of heat, would raise the temperature of a pound of water one degree F. He fixed the dynamic equivalent of one degree of heat as equal to lifting 1 lb. 722 feet high.

This measurement has been generally accepted, and we can, by its means, get at the correlative force which exists between the results of vital energy in the one direction and the circulation of the blood or the temperature of the body as kept up by the consumption of food in another.

By the aid of this formula we can look at the value of hydro-carbons as motive power and decide to use them accordingly.

The list includes the following, viz. :—

1. Starch—the principal agent in bread.
2. The various sugars—cane, grape, lactine, inosite and amyloid.
3. Gum, dextrine, cellulose and woody fibre.
4. Lactic and acĕtic acid and their derivatives.

Starch stands first in the list. It is entirely vegetable in its production and forms the major portion of our staple food. Its chemical formula is variously stated as (C_{12} H_{20} O_{10}) or (C_6 H_{10} O_5) according to the formula adopted. It is capable of being detected microscopically, from its defined characteristics, if it has not been heated. Each granule is made up of a series of concentric layers fine and varying in size and shape according to their source. The granules are unaltered by cold water, and in consequence of this resistance to change they may be removed from the investing tissues in which they have been laid down. In boiling water they swell up, then burst and form a mucilage, which becomes gelatinous as it cools. Starch, as such, is not capable of absorption by either the stomach or the intestines. It must be changed in its initial nature. This change, provided the starch has been already altered by heat, is effected by the saliva. This process, however, requires a little time, not however usually allowed. The morsel, being swallowed, reaches the stomach. Here the alkaline saliva is neutralised by the gastric secretion; the starchy food is reduced to a pulp by the movements of the gastric walls, but not further changed in quality. It then passes through the pylorus into the duodenum. Here it meets with the alkaline secretions from the pancreas and other glands; the starch is changed into dextrine, then into cane sugar, becoming grape

sugar in a short space of time, and now by its diffusibility being capable of rapid absorption by the agencies which exist for that purpose in the alimentary canal. It may reach the liver in the form of dextrine or sugar. The latter organ deals with it according to the wants of the system or the condition of the liver itself. It is by these means brought within reach of the furnace of life and is ready for use as a force producer, where we will leave it for the present.

All starch, if it is to be of use, goes more or less through this process. If it escapes the action of the saliva or of the juices of the intestinal glands, it passes on to the lower part of the canal and out of the body by the rectum as useless matter. But it may be changed into Lactic acid. Lactine, or sugar of milk (C_{12} H_{22} O_{11}), is one of the materials which are found in digestive processes, but its use need not be followed now. There are some intricate questions as to capability of starch to form fat, and the interchangeability of various other agents into one another in the animal economy; but these questions are beyond our scope.

Inorganic substances must not be passed over as adjuncts only in building up and renovating the human machine. They are essential parts of it; so essential, indeed, that life cannot be maintained without portions of them—portions, in some cases, very minute, but which are fundamental necessities. Carbonate and phosphate of lime, their allies the alkalies, potash and soda, are more or less present. Without calcium and phosphorus, as before mentioned, the fabric could not be built, and without soda and potash circulation would not be carried on, for sodium salts are necessary parts of the serum of the blood and the juices of other parts of the fabric, whilst potash enters largely into the constitution of the blood corpuscles. It is by the action of these antagonistic agents that chemical changes are carried on in the blood corpuscle. Iron is also found as an essential part

of the blood disc, whilst other substances exist in minute quantities, and their absence may possibly lead to complications and disturbances, setting up disease.

We have now enumerated the principal ingredients which go to form food and we are in a position to consider the different points in their bearing upon the structure, the nourishment and the renovation of the body.

It is the custom for dietaries to be constructed on the basis of the food required in health as to amount and variety. It is evidently of importance that there shall be a co-operation so arranged that there be not an excessive quantity of nitrogenous matter when the frame is fully formed, or of force producing material when the machine is not called upon to use muscular exertion.

The diet required for a nobleman's ornamental domestic is evidently quite different in character from that which a coal-heaver or navvy will consume. If we arrange the diet for each of these and bestow it on the wrong person, the machine so treated will be put out of order and illness will result. We have therefore to arrange our dietary according to the requirements of the person dieted. This necessitates a division into classes.

This division is found in hospital practice, which varies somewhat in different establishments, but is usually arranged under the heads of *full* diet, *half* diet, *low* diet. These again are sub-divided according to the age and sex of the recipient.

Our first duty, before we can draw out a satisfactory dietary table, is to find out the relative value of different classes of food as force producers and their power to build up the human frame. With that object in view we will now consider each class of material usually at hand for such purposes.

The first great division is, of course, into animal and vegetable food. The meat of animals is largely nitrogenous and is therefore designed more for building up and renovation than for force producing, though it is doubtless of use in this

direction also. This is explained by the changes which arise in the process of digestion.

It has been made out by physiologists that the ingestion of a meat diet leads to its disintegration into *urea*, which passes away by the kidneys (and is doubtless an effete product of some vital actions in the body), and a remainder, which is latent until it is required. Urea is a neutral salt, chemically similar to carbonate of ammonia; it is the form in which all the nitrogen contained in nitrogenous food passes away as an excretion, and it rapidly changes into carbonate of ammonia under the new circumstances in which it is placed after it has left the body.

Taking albumen as a typical form of nitrogenous food, Dr. Pavy worked out a table showing its value as compared with other foods. According to his researches, which have been corroborated by the experiments of other observers, about one-third of the albumen passes from the body as urea, leaving behind two-thirds as latent force in the form of carbo-hydrogen and a small proportion of oxygen. This carbo-hydrate appropriates oxygen from without and supplies force as required. Dr. Pavy gives the value of albumen as compared with other typical foods, taking 100 parts of oxygen as the body to be appropriated. It stands thus—

Albumen	150	parts.
Grape sugar (anhydrous)	106	,,
Starch	120	,,
Fat	293	,,

From this table it will be seen that albumen has about half the value of fat, but is more important than either sugar or starch.

Here, then, we have solid ground to start from and to calculate the values according to the latent force capable of being obtained from either class of alimentary substances.

Aliments obtained from the animal kingdom may be conveniently divided into four kinds—

Meats, eggs, milk, with its products cream, butter and cheese, fish and shell-fish.

Meat.

The flesh of animals stands at the head of articles of food as supplying the largest amount of force in the smallest compass. It has varying power according to the nature of the animal from which it is obtained. The meat ordinarily consumed is the flesh of vegetable feeding animals. The value is influenced by age, sex, and other agencies, such as the mode of death, character of food, comparative size and weight, season of the year, and nature of treatment in the day or two preceeding death. In determining a diet table for different classes these points must be taken into consideration. The flesh of young animals is more tender than that of the fully developed, but it has less latent force and is not so easily digested. A weak stomach will not digest veal and lamb so easily as full grown four-year-old mutton; though the latter is rarely to be met with now, as farmers cannot afford to allow their sheep to live over the third winter. Again, the flesh of an aged animal is often so tough that only the most active and energetic muscle-worker can digest it with comfort. Again, the question of season has to be considered. In season or out of season makes a great difference in the digestive value of some classes of meat. The so-called close season should correspond with that in which the animal is breeding and bringing up its young, and the mother, while bearing or suckling her young, is not so satisfactory as food compared with her digestive value at other times.

The question of size, also, is of some importance. This is seen in the South-down mutton or in the Welsh mountain sheep as compared with the immense Leicester breeds. The flesh of the latter is far coarser and of stronger fibre than the smaller animal, and is not so easy of digestion. The time of year must be considered as to some forms of animal food, especially

game and pork. Water-fowl, also, are more likely to disagree in hot seasons than in cold. They keep better and time is given for the removal of rigor mortis, as it is called—that stiffened contraction of muscle which takes place after death and which should have time to pass away before the flesh is cooked. The nature of the food will qualify this to some extent and must be taken into consideration in arranging the diet table. It must be known when the animal was killed, if the greatest advantage is to be taken of the meat provided. The temperature of the year is to be taken into consideration. All meat is at its highest value in the colder seasons. In hot climates, nature herself indicates, in the difficulty experienced in preserving it from taint, that it is not a necessary article of food. But in cold climates this difficulty is not experienced, and meat may be kept for a long time without any other than advantageous changes. I am of opinion that even in this country it would on the whole be an advantage if no meat were consumed during the months of July and August. In those months we find nature bountiful in her supply of fruit and vegetables, and these are the foods which nature intended for use in hot seasons. Beef and mutton are the meats least out of season, that is, animals of these kinds may be obtained free from the disqualifications which occasionally belong to all other kinds of food. But for the consumption of even these articles of food the early winter is the best time. They have had abundance of food of the most luscious kind during the summer months and they are in the finest condition. Later on, during a severe winter or in spring, after being fed with artificial food or root crops, the meat is not so juicy or so digestible as in the early winter. Let me here raise a protest against the custom of feeding animals so as to load them with fat. A very fat animal has been over-fed, and over-feeding does not bring out the primest qualities of the meat. This is well exemplified in the flesh of oxen fed upon the rye-grass of a sewage farm. Such animals are never loaded with fat, but

there is much more muscle than will be found on an animal fed with oil cake and roots up to repletion and fatness. The ribs of beef in the one case, after being roasted, will weigh much more than that fed on oil-cake, and the advantage will be to the consumer, though the hireling cook may not approve because there is not so much dripping for her perquisite. We have noted this fact and strongly recommend it to the notice of those who may come in the way of rye-grass-fed beasts. The mode of life affects the condition of the animal. No fat is to be found in the flesh of the hare, for it is 'swift of foot,' and wild animals seldom have fat in their tissues. As a rule the flesh of such is more nourishing than that of purely domestic kinds. Witness venison: though in winter time the doe is much in season and presents considerable quantities of fat for the epicure to revel in, yet the fatter animal is not so nourishing as that which is less so. The flesh of wild animals is generally of a darker colour and is richer in extractives than that derived from domestic sources. These give the pleasantest part of flavour to meat.

Method of killing has an influence upon the character of the flesh. Hunted animals are more tender than those killed in quietness. This is easily shown in the hare, the flesh of the animal which has been shot being less tender than that caught by the greyhound. Animals which are bled to death keep better and longer than those whose blood is left in the veins. The drainage of the blood carries away excess of liquid and leaves the meat of a paler and firmer texture than when the death has been procured by other means. It used to be the custom to gradually bleed the calf to death, occupying two or three days in the process; but this barbarous practice has given place to more humane measures.

Wholesome Meat.

The cook must be able to determine as to the quality of the meat, especially as to its wholesome nature. Meat cannot be

adulterated, but it may be taken from animals which have died from disease or have been killed in time to prevent such result. Good meat has its own peculiarities. A knife plunged into it, when withdrawn smells sweet and actually pleasant. The colour is neither too pale, too pink, nor of a deep purple tint. The pale condition indicates disease, and the dark tint that it has died from a malady rather than that it has been slaughtered. There has, in fact, been fever of some kind. It should have a marbled appearance, from the presence of the ramifications of minute lines of fat among the muscular fibres. It ought to be firm and elastic to the touch and scarcely moisten the fingers. If it is flabby, moist, and the fat not properly set, the animal was diseased during life. There should be no smell, or, at least, no disagreeable smell. The odour of physic may be sometimes detected by chopping up a portion and washing it in warm water. It should not waste too much in cooking.

The presence of parasites will be visible to the naked eye. Measly pork is caused by the presence of minute worms in the muscle cells. They are called the *Cysticercus cellulosus.* It has a sucker for its head and a bladder-like body about the size of a hemp seed. Pork in which the Cysticercus exists, if eaten raw, as it often is in some parts of the continent, gives rise to tape worm.

Trichina Spiralis is another kind of parasite. It produces a very mischievous and painful fever. Parasites will be killed by complete cooking, but meat infected by these creatures cannot be healthy and should be cast out.

Trichina Spiralis is a spiral worm enveloped in a cyst, and requires a magnifying glass to detect it; but there is a certain mottled kind of appearance in the flesh—minute nodules—which may lead to suspicions, and the glass will at once reveal its nature. Trichina have been found in a variety of animals; the pig is that in which they are most frequent, but they are also found in birds and frogs. The ova are destroyed by heat. Sausages and other food which is eaten raw

in some parts of the continent are means whereby the disease is conveyed to human beings. If the meat be well cooked the danger is averted, but it is better to reject all articles suspected of Trichina as dangerous to the health of the consumer.

The decomposition of meat is a serious cause of unwholesomeness. A series of poisons, now called Ptomaines, have been detected, which rapidly produce fatal results. The flesh of all domestic animals which is in the least tainted is to be rejected as unfit for food. The epicure rejoices sometimes in some kinds of tainted food of the game class. It will be prudent for the careful cook to exclude all which are actually tainted from her dietary, notwithstanding the entreaties of the bon vivant.

The flesh of birds is somewhat different from that of animals; it never contains fat intermingled with the muscular fibres. The latter are finer. It is in this class of food, as fowl, guinea fowl, and turkey, that we find white flesh. This is of delicate flavour, it is very tender (unless old birds are used) and is easy of digestion, well adapted for the weak stomach of the dyspeptic. The flesh of ducks and geese is darker and less digestible than that of fowl. Geese are not in season in hot weather. The flesh of game is more strengthening and less fatty than other kinds of food. The delicacy of its flavour is increased by keeping up to the point approaching taint from decomposition. Game is less likely to produce poisonous Ptomaines in the juices of the creature, as it is probable that they are developed in animals which are suffering from the onset of some blood disease. Wild fowl requires stronger digestive power than either poultry or game, but they are excellent food, especially in the winter season.

Fish.—This article of food is presented in great variety—fresh water fish, salt water fish, dried, salted, or kept in oil. As a diet it varies immensely in its nourishing power. The Hebrew Law-giver forbade the use of fish not covered with scales, or that had not fins, as an article of diet. This appears to

have had its origin in Egyptian prejudices, for such are prohibited by Egyptian priests as well as by the Hebrew law. The flesh of some fish is actually poisonous, but we do not yet know to what principle this is due; such fish is scarcely ever to be found in the market. In some countries the people, especially those living in the northern parts of the world, consume large quantities of fish, and as a rule they are healthy and strong. Fish is not, however, so nourishing as meat, poultry or game. It is less stimulating than meat, and is valuable, therefore, as food for sick folk. It is more rapidly digested and easily reduced to chyme. White-fleshed fish, such as the whiting, haddock, sole, turbot, brill, and plaice, have but little fat. It is almost restricted to the liver in the cod; it abounds here more largely than in any other fish. The amount of nitrogenous matter in white fish is about 18 per cent. Fatty matter is more abundant in salmon, which has a peculiar flesh colour; it is incorporated with its muscular fibre as well as existing as a layer under the skin; it requires more digestive power than white fish. Fish is to be avoided during the spawning season. This rule does not apply to young fish which have not reached the spawning age. The flesh is influenced by the food, and those which are taken from deep waters are the best. Herrings are always light articles of diet when in season; but mackerel must be fresh; they rapidly become tainted and are then likely to cause mischief to the invalid.

Fresh water fish is not so digestible as fish from salt water unless they are cooked as soon as caught and are taken from deep water or rapidly running streams; this especially applies to the trout, the smelt, and the grayling. The eel abounds in oil and wants good digestive power. Dried and salted fish form an excellent article of food if the fish are cured whilst fresh. They contain a large quantity of nitrogenous matter and are very strengthening to fair digestions.

Crimping is used for the purpose of increasing the firmness of the flesh in the case of codfish and skate. The flesh is

sliced whilst the creature is alive. Fish is different from meat as regards rigor mortis. If this has not passed off the flesh is more palatable and more easy of digestion. The firmer the flesh, the better the quality of the fish. The firmness is diminished when rigor mortis passes away.

Shell fish are of two classes. The crustacean, as the crab, cray fish, shrimp, prawn, and lobster; and the molluscan, as the oyster, cockle, and mussel. They supply from 18 to 20 per cent. of nitrogenous matter. They are more indigestible and more likely to produce discomfort than any other article of animal food. They are not, therefore, safe articles of diet for the weak stomach, though oysters are sometimes taken with a relish by those who are in the weakest possible state, and with considerable advantage to the power of the body, if perfectly fresh.

Eggs are important articles of diet for all classes of people. They contain 14 per cent. of nitrogenous matter, more than 10 per cent. of fat, and from 1 to 1½ per cent. of saline ingredients. The yolk contains a larger quantity of fat than the white, the difference being made up by water in the white with nearly 20 per cent. of nitrogenous matter. Hard boiling, by coagulating the albumen, makes eggs less digestible and apt to cause constipation. They contain a minute proportion of phosphorus, which, in the process of hatching, acts upon the shell, and takes up the lime by means of which the bony structure is commenced. Eggs contain all that is necessary for the support of life and the growth of tissue, and they contain the largest proportion of the necessary elements for this purpose in the smallest proportion of space.

Milk, Butter, Cheese, Cream.—These ingredients contain all the elements necessary for the growth of the body and the maintenance of life. The milk of the cow varies somewhat, but only in degree, from the milk of womankind. Nature provides it as the only food necessary for the nourish-

ment of the infant; it is the type of an alimentary body, and its constituents may be studied with the certainty of knowing what nature requires for the growth and maintenance of human existence. The constituents are—nitrogenous matter about 4 per cent., fatty matter nearly as much, lactine or sugar of milk about 5 per cent., saline matter nearly 1 per cent., and water 86 per. cent. The specific gravity of good milk which is unadulterated varies very little from 1030. Some analyses vary a little from these figures, but they indicate the average. The nitrogenous matter is principally composed of caseine, which is not coagulable by heat, but is so by acids of all kinds. Exposure to air brings about this change in due course, when the liquid part becomes sour and the caseine curdles. The smallest quantity of this curd will hasten similar changes in new milk, hence the necessity for the greatest possible cleanliness in dairies. The tendency to curdle is manifested much more rapidly in warm weather; the hotter the day, therefore, the more difficult to keep milk in its natural state. The fatty matter constitutes butter. It exists as microscopical globules of fat, which tend to aggregate by motion, acting on the mass of milk; the serum separates as butter-milk, and in the latter are found salts natural to the milk. Good milk should show certain proportions of butter-fat, which rises to the surface on placing the milk aside for a time. Payen gives a table showing the difference between women's, cows', asses', mares', and goats' milk; it is worth consideration when the digestive organs of a child have become upset by causes connected with the supply afforded by the mother.

The quality of milk is much influenced by the food supplied to the mother. The latter can affect her infant by mental excitement; a fit of passion, indulged in by the mother, has been known to produce convulsions in the child; intoxicants have a deadly influence on the baby, the narcotic influences being occasionally superseded by the irritating action of the drug on the nervous system of the child. Children of total

abstainers do not suffer from these disturbances. Aperients exhibited to the mother affect the child through the mammary gland. The milk of the cow is also influenced by the food with which the animal is supplied. The milk of the cow corresponds most closely with that of woman, but on the whole he quantity of solid ingredients is greater. The milk of the goat comes next, but it is also more highly charged with sólids. The milk of the ass and mare contains a larger amount of lactine and a decrease of the other solids.

The quality of milk varies in different breeds of animals. The richness of the milk of Alderney cows is a case in point; they are better butter producers, whilst the long horns supply the largest amount of caseine. A volume might be written upon the variations of milk and the changes induced in it by sophistications of various kinds, which outstrip the efforts of science to detect them. I must refer to chemical publications for these particulars.

Cream should constitute 10 per cent. of ordinary cows' milk. Skim-milk should show rather a higher specific gravity than new milk ; butter-milk also.

Devonshire or clotted cream differs from ordinary cream in being solid. It is collected from milk heated to 209 or 210 degrees. A scum forms and collects the oil globules.

Pure milk has a specific gravity of 1030 ; the addition of water lowers this. This may be somewhat counteracted by taking away some of the cream. The examination of the skimmed milk will show this artifice. Milk diluted with 15 per cent. of water gives a specific gravity of 1026, 20 per cent. of 1025, 50 per cent. reduces it to 1016. The examination of whey will follow similar reductions when water has been added. The cook may detect this adulteration if at the same time the lactometer is used by her, not however in a sufficiently accurate manner to put before a court of summary jurisdiction, yet enough to show whether the supply comes from an honest source. The lactometer is a glass tube which

indicates the percentage of cream in the specimen under examination.*

Butter is obtained by the process of churning, either cream or milk being used for the purpose. It requires a temperature of about 60° F. for its successful and rapid formation.

Pure Butter is an excellent article of diet, but as it does not contain much nitrogenous matter it supplies force production rather than assistance in building up the frame. It consists chemically of a variety of materials which enable the analyst to verify its quality. It is prone to undergo change in hot weather, and soon becomes rancid. It may be preserved for a long time from this change by the addition of salt. The change is produced in the small amount of nitrogenous matter which is left in the butter when it separates from the butter-milk. Salt may be washed out, and then the washed butter is as good for cooking purposes as fresh butter. The salt in it, moreover, is not an objection in most cooking operations.

Cheese consists of the caseine of milk with a varying proportion of oily matter or fat, according to its source. There are a great number of varieties of cheese; its average composition consists of—nitrogenous matter, about one third; fatty matter, a fourth part; salines, about five per cent., and the rest water; but analyses are made to differ by chemists of equal standing, which shows that the milk from which the cheese has been obtained varies in its chemical composition; but the mean is about as stated. It is a very valuable article of food from the large amount of nitrogenous matter which it contains, rising to a higher figure in the cheese obtained from skim milk. To the poor it supplies the nitrogen which is wanting when the supply of meat is deficient. It is digestible according to the power of the recipient; in small quantities it may increase

* It has lately become the custom for dairymen to chill new milk by passing it through a refrigerator, the result of which is to prevent its turning sour.

digestive power, but to some it is very difficult. Toasted cheese, from certain changes in its physical state, is exceedingly indigestible. Cheese is liable to undergo certain changes from age or imperfect manufacture. It may be loaded with jumpers, as the maggots which form in it are called—*piophila casei*—or be consumed by cheese mites (*acarus*), which are sure to take possession of it in time. It may be covered by blue mould—the fungus called *penicillium glaucum*, or of the red mould—*sporendonema casei.* It sometimes becomes very rancid, and will, as putrefaction extends, produce some highly irritating poisonous matter, capable of giving rise to dangerous symptoms in those who consume it. In this state it ought to be destroyed by fire.

Vegetables as articles of food. The circulation of matter from animals to vegetables, and through the latter back again to the animal world, is one of the most wonderful provisions of nature. Animals would all perish if the renewal of spring did not bring new vigour into vegetable growth. It is presumable that but for the aid of animal oxidation carbon might not be forthcoming in sufficient proportion to support the growth of the vegetable world. That the perverse action of humanity in destroying the exuviæ of human beings by burying it in cess-pits, destroying it by chemicals, or throwing it away into the sea, is having an injurious influence upon the fruits of the earth in the British isles is in my opinion an established fact. The land should raise sufficient food for its inhabitants. It does not do so. The inhabitants are dependent upon foreigners for the growth of food. Their goodwill is necessary for our safety. Statesmen are not wise to leave the country in this position. There ought to be food enough grown within the British isles to feed the people: this could be accomplished if the laws of nature were observed, and all human exuviæ conveyed to the soil for use again. Vegetable life is the sequence of animal decay. It supplies the nitrogen which is required to lay the foundation of new tissue, as well as the fuel required to keep

up temperature to working point. It has been already shown that albumen and fibrine in animal food correspond chemically with that which is found in vegetables. It is possible for animals to live entirely on vegetables; indeed, all those raised for domestic purposes are vegetable feeders. There are also large portions of the human race who never touch animal food. Nevertheless, human beings are evidently designed by nature to be omnivorous—that is, to be able indifferently to assimilate both kinds. A study of the natural history of man shows us that a bountiful nature supplies what is most suitable in all parts of the world; that in those climates in which there is great heat, as in the tropics, fruit and vegetables are sufficient to sustain life; which is indeed best promoted by that kind of diet; whilst in the colder regions tempting vegetables do not abound, but the colder it is the larger the quantity of fat that becomes grateful as a diet for humanity.

Vegetables are divided into various groups, according to their prevailing characteristics, viz.—

(1) Farinaceous seeds. (2) Seeds containing oil. (3) Roots or tubers. In addition we have also various preparations derived from herbaceous, saccharine and other preparations.

Farinaceous foods stand first in value; they contain the largest amount of nutritive matter. Wheat, barley, rye, oats, maize, Indian corn, are all derived from the grass tribe. Then follow the legumes—peas, beans, lentils.

Wheat gives an average amount of about 20 per cent. of nitrogenous matter, 60 to 70 per cent. of starch, 2 to 3 per cent. of fatty matter, and about the same of mineral ingredients. Dextrine and cellulose make up the rest. Different kinds of wheat differ materially from these averages, and vary in their values accordingly. When reduced to the form of flour it is deprived of its outer covering. Nature never intended that this course should be pursued, or the outer covering would not have been so intimately united with the inner contents. This tegument constitutes the so-called bran; it is indigestible in its

nature, and useless as an article of nutrition. It is of an irritating character in the small intestines, and promotes the natural movement of the intestinal canal and thus decreases the probability of constipation. It must be avoided when there is irritability of intestines. This power must be considered in providing food for those who suffer from the one condition, as well as the other. Beneath the branny scale is a finer membranous matter, called the cortex. It is the richest in nitrogenous matter, phosphates, salts, and fat, and has considerable value as food. Here also is situated a matter which is capable of turning starch into sugar; it is similar to diastase in its action, and is called cerealine by chemists. It has a metamorphic influence during the process of digestion. It is present in a greater quantity in brown than in white bread, hence the easier digestion of the former and its greater nutritious value as an article of food. The whiter the bread the larger the proportion of starch, and the smaller the quantity of cerealine, fibrine, or fatty matter. If wheat be well washed so that all the starch be removed a material called gluten is left. It is the presence of this material which enables the cook to change wheat flour into bread. It is very tenacious, and solidifies when heated, and it encloses the gas which is generated in the process of fermentation. This process is set up by means of a fungus which grows very rapidly in moistened flour if it be kept at the requisite temperature. The yeast fungus flourishes most rapidly in the process of fermenting malt liquor. Brewers' yeast is the most easily available source of the supply, but a material called German yeast has been introduced into the market which varies less in quality; and since the introduction of other things than hops in the brewery, German yeast has beaten brewers' yeast almost out of the market. The growth of the fungus sets free carbonic acid gas, which, entangled in the plastic gluten, causes the dough to rise, and produces the lightness which is the characteristic of wheaten bread. Brown bread does not take the

fancy of the consumer so much as the whiter sort, but it contains more force-producing elements, and is more nutritious in consequence. It is darker in colour from the larger quantity of gluten. When this is removed it is called pollards, and is given as food to domestic animals; and so it eventually becomes a food for human beings in the form of meat. Persons who eat much animal food may consume white bread without loss. Those who get but little animal food will do better on brown bread.

The art of the baker is exercised in the effort to fix as much water as possible in the batch of bread which is to be made from a sack of flour. 96 quarten loaves is the usual average; but many bakers try to get more by adding a small quantity of boiled potatoes or ground rice flour, or even other more objectionable means, such as water in which a minute proportion of alum has been dissolved. This latter ingredient increases the whiteness of the product, and also enables the baker to use more water in setting the baking, as it is called. It is a custom which is wrong in principle, and bad for the health of those who eat the bread. New bread is less digestible than that which is two days old. Home-baked bread is supposed to be free from the chances of adulteration, but it is more apt to turn sour if kept long, whilst bakers' bread becomes dry and unpalatable from a different cause. Flour is sometimes damaged by the flour mite, but that is destroyed in the baking. It would be much better for all people if seconds flour (as it is called) was generally used. Curiously enough the working classes prefer the whiter breads, though there is more sustaining power in the browner varieties because there is more of the nitrogenous matter and fat of the grain in the composition. Bran is sometimes added to the flour to make brown bread. It is capable of irritating the weak digestive organ and setting up diarrhœa. Whole meal, as it is called, has become a favourite article of food. It consists of the whole of the

grain, less the actual bran, ground up together. It contains the larger part of the phosphates, and all the nitrogenous matter. Miss Yates has spent her life in trying to introduce it to the notice of workpeople, and to show its nutritious quality as compared with white bread.

Unfermented breads are also to be now easily obtained. In these the lightness is obtained by chemical means. Carbonic acid is forced into the dough in Dr. Dauglish's method, it is carried out by machinery, so that it is scarcely touched by the hand of man.

Baked flour is a very useful article for young children. A basin is filled as full as possible, it is then tied down with a cloth like a paste pudding. It may then be boiled for some hour or two, and afterwards dried in the oven. The water does not penetrate the flour, the starch grains are ruptured by the heat, and the flour is more easy of digestion in consequence. In practice, 100 lbs. of flour will make about 135 lbs. of bread, the excess representing the water which has been appropriated in the process. A large part of this evaporates in the course of three or four days, so that stale bread is much lighter than new.

Biscuits are unfermented; they consist of flour and water, and exist in great variety. Dr. Letheby's analysis shows that they contain, on the average, 15 per cent. of nitrogenous matter, 73 per cent. of carbo-hydrates, fatty matter 1½ per cent., mineral matter nearly two per cent., and the rest water. They are very useful articles of diet, and being capable of preservation for a long period are of great value when bread cannot be manufactured.

Rice is the food of a very large portion of the human race. Paddy is the name of the seed before it is deprived of the husk. This has to be removed before the rice is fit for food. It contains 6·3 per cent. of nitrogenous matter, nearly 80 per cent. of carbo-hydrates, scarcely one per cent of fatty matter, not half per cent of salines, and the rest water. It is much

inferior to wheat flour as a sustaining agent, but what it lacks is missed the least in the hot climates in which it is the staple food of the people.

Indian Corn or Maize now occupies a large place among food stuffs ; it is of tropical origin ; it is not adapted for bread making in consequence of the absence of gluten ; if it be used for this purpose a portion of wheaten flour is mixed with it. In some parts of America rye flour is mixed with the maize meal. It is used in Ireland since the failure of the potato crop, and is made into a form of porridge. Its slightly unpleasant taste may be removed by the addition of a small quantity of soda. Oswego, maizina, and corn flour are manufactured from maize flour. Dr. Letheby gives its nutritive value as—nitrogenous matter 11 per cent., hydro-carbons 65 per cent., fatty matter 8 per cent., salines nearly 2 per cent., the rest water. It is shown to contain a very large percentage of fatty matter, and its large amount of nitrogenous matter places it in a superior position as a food supply.

Oatmeal is the material which, mixed with water or milk, constitutes porridge. The oat is first kiln-dried before the inner grain is crushed. When separated, and before crushing, it constitutes Embden groats. It cannot be made into bread without mixture with wheat or rye flour. In Scotland and Wales it is made into a paste, and, spread out in thin sheets, forms the cakes which enter largely into the food supplies for the people. Hence Scotland is said to be the land of cakes. Oatmeal has a large supply of nitrogenous matter, viz., 12½ per cent., carbohydrates 64 per cent., fatty matter from 5 to 6 per cent., salines 3 per cent., and water 15 per cent. The nitrogenous matter is allied to caseine. The large supply of salines is made up of phosphates, and its quality is said to account for the high cerebral development of the Scotsman who has been fed upon porridge. This is made by stirring the meal with boiling water until it forms a paste-like mass ; it may be then eaten with milk or treacle, and is a highly sustaining diet.

Gruel is made in a similar manner; but using in the first instance cold water for the purpose of mixing the meal, then boiling for ten minutes, continuing the process of stirring whilst on the fire, adding milk and sugar according to taste.

Barley.—Pearl barley is the barley grain, deprived of the husk, and rounded by friction. Patent barley is pearl barley meal. The composition of barley meal, according to Letheby, is as follows:—Nitrogenous matter, 6 per cent.; carbo-hydrates, 74 per cent.; fatty matty, 2½ per cent.; salines, 2 per cent.; water, 15 per cent. The nitrogenous matter exists as albumen and caseine. Barley cakes are less digestible and more laxative than oatmeal. The principal use of barley is to form **Malt**, which is the sprouting corn, moistened in the first instance with water, and kept in a warm atmosphere; it is then kiln-dried, and the process of germination stopped just when the carbo-hydrate has been changed into sugar by the nitrogenous matter contained in the seed. The process of fermentation with yeast fungus sets free carbonic acid and turns the sugar into alcohol.

Rye is cultivated in some parts of Northern Europe as a bread stuff. It contains much nitrogenous matter, viz., 8 per cent.; carbo-hydrates, 73 per cent.; fatty matter, 2 per cent.; salines nearly the same; and water, 15 per cent. It approaches to wheat more nearly than any other grain, and is capable of being made into bread; but it is apt to be sour and disagreeable to the taste, and is rapidly giving place to wheat in those districts into which the latter can penetrate; but rye is easier of cultivation and grows on soil which will scarcely grow anything else.

Millet and buckwheat are occasionally used as food stuffs, but more for poultry than for human beings.

Peas and Beans have a high nutritive value; they furnish a very satisfying article of food. Beans and bacon constitute a dish of super-excellence as containing all the elements requisite for force-production. They require prolonged boiling and

then the good digestion of active muscular work to enable them to be properly assimilated. They contain from 25 to 30 per cent. of nitrogenous matter; more than 50 per cent. of carbo-hydrates; mineral matter, $3\frac{1}{2}$ per cent.; water, 10 per cent.

Tuber or **Potato** is a most important article of food; it cannot be eaten in its raw state. The composition is said to be nitrogenous matter, 2 per cent.; carbo-hydrates, 19 per cent.; fat, ·3 per cent.; salines very little, hardly amounting to 1 per cent.; and water, 75 per cent. The presence of a large proportion of starch is its characteristic feature. It is from this tuber that it is mainly obtained, by washing out the grains by means of cold water. Steaming is the best process for cooking potatoes. If they be boiled the skin should not be removed, as otherwise some important qualities are removed from the tuber. Letheby says the waste in their skins is only 3 per cent. as compared with 14 per cent. when the skin has been first removed. The potato contains so little fat or nitrogenous matter that it requires meat or fat food to be eaten with it to make it a complete dish. If it be associated with butter-milk it forms a comparatively inexpensive article of diet which is extremely nourishing.

The parsnip and carrot also furnish useful dishes, but of less sustaining character, and the turnip comes last, as supplying the largest quantity of water.

Herbaceous Vegetables.—Cabbages, spinach, celery, artichokes, asparagus, lettuce, endive, onions, cresses and many other articles are also consumed with advantage when combined with more nitrogenous foods; and lastly, we have the edible fungi, as capable of affording, in the hands of the cook, a very large addition to our food supplies.

Fruits.—The term is intended to apply here to those articles which contain a vegetable acid in their composition—as apples, pears, plums, currants, gooseberries, strawberries, and such like. They are extremely useful in a diet table, and in hot climates are necessaries of life. They are most grateful

to the feverish patient, especially such as grapes, apricots and peaches; but they must not be used except under medical advice in such cases. In their natural form the juices they contain consist of the nallates and citrates of the alkalies with sugar, usually in the form of grape-sugar, cane-sugar being obtained from the juice of the sugar-cane, which is not a fruit, but the stem of the sugar-palm. If this acid juice is expressed and treated with yeast it ferments and gives rise to the various wines which constitute intoxicating liquors, and are not necessaries of life.

CHAPTER II.

THE EFFECT OF COOKING UPON FOOD.

It is said of man that he alone of all creation is a cooking animal; he alone alters the character of food by exposing it to heat before he feeds upon it. By doing so he renders it more digestible, and, in the case of animal food, less repulsive to the sight, and more agreeable to the taste. Cooking develops the flavour of the meat. It is also rendered more easy of mastication by the process of roasting, boiling, frying, baking, or steaming, as the case may be. Heat will also destroy any living organisms which may have developed in the dead animal or lived upon it as parasites during life; heat coagulates the albumen, gelatinises tendon and connective tissue, solidifies fibrine, and changes the mass into a soft, gelatinous mixture capable of comfortable mastication. Meat and vegetables are all more digestible after a proper kind of cooking, though but too often the cook does not know her business. It is said of English cooks that they make tender and good meat tough, whilst French cooks make tough meat tender. This is true to some extent, because the first principles in cookery are neglected in teaching cooks their business. We will give the first principles as shortly as can be done:—(1) Boiling. (2) Stewing. (3) Frying. (4) Roasting. (5) Broiling. (6) Baking.

Boiling.—The great point is to prevent loss of weight and to increase tenderness; its nutritive principles should be kept in the meat as much as possible. The larger the portion to be boiled the better. It should be plunged suddenly into boiling water, and should be boiled briskly for about six minutes, then withdrawn, and the heat kept at about 170° until it be done—the time required will depend upon the size of the

joint. If it be boiled at full heat the meat is rendered hard, tough, and less digestible; the muscular tissue shrinks and there is loss of weight to a much greater extent than if the heat be kept at 170°; in the former case the juices are extracted, in the latter they remain in the meat. When broth is required the meat should be boiled freely for more than half an hour, having been previously cut up into small pieces. The juices are extracted and remain in the water. In boiling vegetables it is better to use rain water or soft water when possible to obtain it. It has a more rapid action on the starch granule in the vegetable, causing it to swell up and burst more rapidly than when the boiling is with hard water. The central part of the grain is at once presented to the action of the digestive juices. Boiling extracts from the vegetable certain gummy, saline and extractive matters, which are left in the liquid. Hard or salt water is better to be used if there be much sugar in the vegetable to be cooked. Salt preserves the colour of the vegetable, but it is at the expense of tenderness. The eye is pleased at the expense of digestibility. Fish are best when boiled in hard or salt water, especially if they are cooked before rigor mortis is established. Fish boiled in sea water are more highly flavoured; if sea water is not available, salt should be added, so as to bring it near the condition of sea water, but not sufficiently salt to make the flesh taste salt. Potatoes should be boiled in their skins; a great loss of feeding power takes place when they are peeled before boiling; their flavour is lost, and they are less digestible. The loss of weight by boiling, according to Letheby, is about 20 per cent.; it is less than is the case in any other process.

Stewing is the most favourable process as far as digestion is concerned; the meat should be just covered with water and gently simmered (not boiled at all). The principal part of the food passes into the liquid, but the connective tissue is gelatinised. *Hash* is a term applied to meat which has been

cooked before. This kind of cooking renders the meat very indigestible, if it is boiled, but if kept for some time at a temperature of 160° it is rendered fairly digestible, but much less feeding than meat is after one cooking process only. Indeed, to some delicate stomachs it is a useless food.

Frying is a process which assists to make some meats or fish more tasty to strong digestions, but in consequence of the action of heat upon the fat or oil in which the article is usually fried the process adds to the difficulties of digestion. It is not to be recommended for weak stomachs.

Roasting is the most in demand by ordinary people, though it leads to greater waste. The loss reaches the high figure of 30 per cent., or even more if the cook does not understand her work. The loss is caused by evaporation, and the breaking down of the fat cells, the oil escaping in the shape of *dripping.* Roasting should be conducted on the same lines as boiling—sudden exposure to considerable heat, so as to form a coating of coagulated matter around the joint to keep in the juices; then a withdrawal, so as to let heat get into the joint in a gradual manner. The juices are kept in and escape in the form of gravy when the joint is cut. The fibrine is not hardened, whilst the heat develops the pleasant flavours to be found in the extractives, and gives the appetising varieties to properly roasted joints. Mutton loses from 4 to 5 per cent. more than beef in the process.

Broiling is somewhat similar to roasting, but inasmuch as it applies to smaller joints it is more rapid and more wasting.

Baking, when properly done, is less wasteful, the juices are retained, and there is less escape for empyreumatic products. The result is not so digestible as boiled or roasted joints. There is more force matter for the active worker.

Steaming is an excellent way of cooking. It is a combination of boiling and stewing; as has been already remarked, steamed potatoes are far preferable to boiled. Roasting

renders them still more nutritious, but it is more wasteful. The so-called Norwegian kitchen is the best apparatus for affecting this plan of cooking. It consists of a box which is felted inside, or lined with some non-conductor of heat; inside this is placed an earthenware pan containing the dish to be cooked; the pan, before it is put into its jacket, is boiled in water for a few minutes. It is then taken out and rapidly conveyed into its jacket, sometimes with an outside envelope containing boiling water, but with a small hole in it for the escape of steam into the pan. The cover is then placed and screwed tightly down. The apparatus may then be conveyed anywhere, the cooking operation being completed in transit. It is an extremely satisfactory way of providing food for travellers on long journeys, or in positions in which it might be impossible to get hot dishes. The heat is retained in the vessel. In hot climates the process may be reversed, and it may be used as a refrigerator, ice taking the place of the water in the outer jacket of the container.

Smoking, Salting, Pickling are all ways by means of which meat, fish, &c., may be preserved for a long time, so that the chances of starvation may be avoided. It is, however, to be borne in mind that human nature cannot subsist for very long upon such food. Fresh food in the shape of meat or vegetables must be sooner or later provided, or the recipient will suffer from scorbutic affections. Scurvy used to be the scourge of the sailor until it was discovered that lemon juice was a perfectly certain antidote; but fresh vegetables or fresh fruit are still better fitted for the purpose.

Diet Tables.—We are now in a condition to approach the subject of diet tables for all classes. Joule has shown us the means whereby we may estimate the values of different articles of diet by observing the quantity of hydro-carbon material required to elevate 722 lbs. of water one degree in temperature, which will correspond with the elevation of the same material one foot high. The value of the food, therefore, will

be measured by the amount of hydro-carbon in a digestible form, especially when in combination with nitrogenous material, capable of acting on the combined mass and changing it into available matter for force production.

A healthy adult requires an amount of food which is found by experience to be proportional to Joule's table. A man doing little work should be satisfied with a smaller amount than that which the hard-worked man requires. The constituents are not capable of computation from milk, as that is a perfect food for children and old people, but not for adult life. Experiments have been made upon bodies of men at work and at rest, their food has been weighed and excreta calculated. It has been found that the requirements of a man at rest correspond with the weight of the body, and taking the average weight at 150 lbs., the food should contain, exclusive of water, materials in the following proportion, viz., carbo-hydrates, about 12 oz.; fats, $3\frac{1}{2}$ oz.; albuminates, $4\frac{1}{2}$ oz.; salts, $1\frac{3}{4}$ oz.; amounting to nearly 22 oz. in the 24 hours. Ordinary food contains usually from 50 to 60 per cent. of water, exclusive of liquids, taken with it. The power of individuals as to capacity to digest food will vary according to activity, size, &c.

The proportions of a diet table should be in accord with these quantities. The work to be performed should be taken into consideration and the supply increased according to the requirements. If a man has to raise so many foot tons (as it is called) he must be provided with more food in proportion. It is found that a man walking a mile an hour equals the raising of 7·6 tons lifted one foot high; 2 miles equals 35 tons. If walking one mile and carrying 60 lbs. it is equal to raising $24\frac{3}{4}$ foot tons. If a man is at the same time ascending a height, the weight of his own body must be added to the weight raised. The following is the diet table for able-bodied paupers approved by the Local Government Board, and is based upon practical experiments.

DIETARY OF THE ABLE-BODIED INMATES.

		Breakfast.		Dinner.							Supper.	
		Bread.	Gruel.	Bread.	Cooked Meat.	Potatoes or Vegetables.	Suet Pudding.	Soup.	Broth.	Cheese.	Bread.	Cheese.
		Oz.	Pt.	Oz.	Oz.	Oz.	Oz.	Pt.	Pt.	Oz.	Oz.	Oz.
Sunday	Men	6	1½	...	5	10	...	...	...	...	6	1½
	Women	5	1½	...	5	10	...	...	...	...	5	1½
	Children, 9 to 16	5	1	...	4	10	...	...	...	...	5	1½
Monday	Men	6	1½	...	...	...	14	...	...	...	6	1½
	Women	5	1½	...	...	...	14	...	...	...	5	1½
	Children, 9 to 16	5	1	...	...	...	12	...	...	...	5	1½
Tuesday	Men	6	1½	4	...	...	...	1½	...	...	6	1½
	Women	5	1½	4	...	...	...	1½	...	...	5	1½
	Children, 9 to 16	5	1	4	...	...	...	1	...	...	5	1½
Wednesday	Men	6	1½	...	5	10	...	...	...	...	6	1½
	Women	5	1½	...	5	10	...	...	...	...	5	1½
	Children, 9 to 16	5	1	...	4	10	...	...	...	...	5	1½
Thursday	Men	6	1½	...	...	...	14	...	...	...	6	1½
	Women	5	1½	...	...	...	14	...	...	...	5	1½
	Children, 9 to 16	5	1	...	...	...	12	...	...	...	5	1½
Friday	Men	6	1½	4	...	...	...	...	1	...	6	1½
	Women	5	1½	4	...	...	...	...	1	...	5	1½
	Children, 9 to 16	5	1	4	...	...	...	...	1	...	5	1½
Saturday	Men	6	1½	6	...	...	...	...	...	2	6	1½
	Women	5	1½	5	...	...	...	...	...	2	5	1½
	Children, 9 to 16	5	1	5	...	...	...	...	...	2	5	1½

Soup Ingredients.—Peas or Pearl Barley, 1 pint; Rice, 12 oz.; Oatmeal, 6 oz.; and Shins, 2 oz.; to a gallon, and liquor in which meat was boiled the previous day.

Broth ,, Scraggs, 2 lb.; Rice or Flour, 8 oz. to a gallon; Liquor in which meat was boiled the previous day; and Leg of Mutton Bones. Meat remains in broth.

Pudding ,, Flour, 9½ oz., and Suet, 1½ oz., to a Pound.

Gruel ,, Oatmeal, 2 oz. to 1½ pints of Gruel.

The Ward Helpers, Workers in the Laundry, Kitchen, and Matron's kitchen may, at the discretion of the Master, have a daily allowance of meat 5 oz., butter 1 oz., tea 2 pints.

The above table is based upon the proportions which experience has shown to afford sufficient of all the ingredients that nature really requires.

For sick people it is requisite to make considerable changes in this dietary, and to add or subtract according to the nature of the disease.

Hospital authorities, as has been already mentioned, style their diet tables Full Diet, Half Diet, and Milk Diet, or Fever Diet, or Low Diet.

Full Diet may consist of—*Breakfast:* Pint of tea, 4 ozs. bread and butter. *Dinner:* $\frac{1}{2}$ lb. of dressed meat, with $\frac{1}{2}$ lb. of potatoes, 3 oz. bread, and in some hospitals a half pint of beer. *Tea:* One pint of tea, with 4 oz. bread and butter. *Supper:* 3 oz. bread and butter; in some cases beer.

The daily allowance is an ounce of butter during the day, with two pints of beer for men, and one pint for women. In some hospitals the beer is omitted with considerable advantage to the inmates.

Half Diet consists of 1 pint of tea, 12 oz. of bread, a $\frac{1}{4}$ lb. of cooked meat, $\frac{1}{2}$ lb. of potatoes, $\frac{3}{4}$ oz. of butter, and in some cases a pint of beer, distributed as in full diet.

Milk Diet—*Breakfast:* One pint of tea. *Dinner:* $1\frac{1}{2}$ pints of milk, or one pint with arrowroot, rice, or sago pudding, some bread. *Tea:* One pint with bread and butter. *Supper:* bread, butter and gruel.

Low Diet, as it is sometimes called, is ordered for some forms of active disease, and consists of variations of broth, barley-water, gruel, some milk and bread as may be ordered. Children under ten are usually considered to require half as much as the adult.

In St. Thomas's Hospital the diets used to be, and probably are still:—

Full Diet—Daily allowance: 12 oz. of bread, $\frac{3}{4}$ oz. butter, 2 pints of tea with milk and sugar, 4 oz. of beef or mutton alternately, $\frac{1}{2}$ lb. of potatoes or fresh vegetables, half a pint of milk or beer, if ordered.

Half Diet—12 oz. bread, $\frac{3}{4}$ oz. butter, $1\frac{1}{2}$ pints of tea with milk and sugar, 4 oz. of meat (3 oz. for women), $\frac{1}{4}$ lb. of potatoes or other vegetables, 8 oz. of rice or bread pudding, with $\frac{1}{2}$ pint of milk. If the medical officer orders fish, meat is omitted.

Milk Diet—*Breakfast:* One pint of tea with bread and butter. *Dinner:* $1\frac{1}{2}$ pints of milk, or pint of milk with arrowroot, rice or sago. *Tea:* The same as for breakfast. *Supper:* Bread and butter with gruel. The bread is not weighed out. Children under nine years of age receive half allowance.

Each patient on admission is placed on milk diet until the medical officer places him in his proper position, but there is much discretion as to kind of diet, and alterations are made frequently in accord with the disease of the patient.

Below is inserted the diet table employed in a county lunatic asylum containing 1,200 patients, and which has recently passed into the hands of the London County Council. Some alterations are to be made in this table so as to bring it into accord with the other asylums belonging to this new authority, but I do not at present know why it is considered necessary.

I also give the dietary allowed by the Local Government Board in a large pauper school containing nearly 1000 children. The pauper establishment, the general hospital, the lunatic asylum, and the school give foundations for the arrangements of any necessary dietary which may be contemplated. And in all these establishments the writer has had personal experience of the working of the dietary.

DIET SCALES FOR LUNATICS.

DAYS.		Bread.		Meat.		Fish.		Potatoes Peeled.		Flour.		Treacle.		Oatmeal.		Carrots.		Turnips.		Onions.		Suet or Dripping.		Luncheons to Workers only. Bread.		Luncheons to Workers only. Cheese.	
		M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
		oz	oz	oz	oz	oz	oz	oz	oz	oz	oz	oz	oz	oz	oz	oz	oz	oz	oz	oz	oz	oz	oz	oz	oz	oz	oz
Sunday ...	Baked Meat	16	12	7	6	...	...	16	12	...	...	...	...	...	...	...	...	...	...	½	½	...	...	4	3	1	1
Monday ...	Boiled Meat	16	12	7	6	...	...	16	12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	3	1	1
Tuesday ...	Irish Stew and Pudding	16	12	2	2	...	...	16	12	6	5	¾	¾	¼	¼	1¼	1¼	1¼	1¼	1¼	1¼	1	1	4	3	1	1
Wednesday	Meat Pie..............	16	12	6	5	...	...	12	8	5	4	...	...	...	...	...	...	...	...	...	...	1	1	4	3	1	1
Thursday	Roast Meat	16	12	7	6	...	...	16	12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	3	1	1
Friday......	Fish	16	12	...	...	20	16	16	12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	3	1	1
Saturday...	Dumplings...........	16	12	3	3	...	...	12	8	4	4	...	...	...	...	...	...	...	...	...	...	1	1	4	3	1	1
	Weekly Total...............	112	84	32	28	20	16	104	76	15	13	¾	¾	¼	¼	1¼	1¼	1¼	1¼	1¾	1¾	3	3	8	21	7	7

EXTRA FOR WORKERS.

To Females employed in Workrooms }
Ditto ditto Laundry } 2¼ lbs. Tea and 9 lbs. Sugar, Weekly, per 40 patients.
Ditto ditto Main Kitchen }

Oatmeal or Lime Juice drink to Males employed during the warm weather, on the Estate and in the Workshops.
Oatmeal or Lime Juice, 16 oz. Sugar, 9 oz.; Water, 3½ galls.

DAYS.	BREAKFAST.						DINNER.																SUPPER.							
	Males.			Females.			Males.								Females.								Males.				Females.			
	Bread.	Butter.	Cocoa.	Bread.	Butter.	Cocoa or Tea.	Meat.	Fish.	Potatoes.	Pudding.	Bread.	Treacle.	Irish Stew.	Meat Pie or Dumpling.	Meat.	Fish.	Potatoes.	Pudding.	Bread.	Treacle.	Irish Stew.	Meat Pie or Dumpling.	Bread.	Cake.	Butter.	Tea.	Bread.	Cake.	Butter.	Tea.
	oz	oz	pts	oz	oz	pts	oz	oz	oz	oz	oz	oz	pts	oz	oz	oz	oz	oz	oz	oz	pts	oz	oz	oz	oz	pts	oz	oz	oz	pts
Sunday ...	6	½	1	5	½	1	7	...	16	...	4	...	...	...	6	...	12	...	2	...	...	...	...	6	...	1	...	5	...	1
Monday ...	6	½	1	5	½	1	7	...	16	...	4	...	...	...	6	...	12	...	2	...	...	...	6	...	½	1	5	...	½	1
Tuesday ...	6	½	1	5	½	1	2	...	16	10	4	¾	1½	...	2	...	12	7	2	¾	1	...	6	...	½	1	5	...	½	1
Wednesday	6	½	1	5	½	1	6	...	12	...	4	...	...	15	5	...	8	...	2	...	...	12	6	...	½	1	5	...	½	1
Thursday	6	½	1	5	½	1	7	...	16	...	4	...	...	...	6	...	12	...	2	...	...	...	...	6	...	1	...	5	...	1
Friday	6	½	1	5	½	1	...	20	16	...	4	...	...	...	...	16	12	...	2	...	...	...	6	...	½	1	5	...	½	1
Saturday...	6	½	1	5	½	1	3	...	12	...	4	...	...	12	3	...	8	...	2	...	...	12	6	...	½	1	5	..	½	1
Weekly Total	42	3½	7	35	3½	7	32	20	104	10	28	¾	1½	28	28	16	76	7	14	¾	1	24	30	12	2½	7	25	10	2½	7

Tobacco and Snuff are given by order of the Medical Superintendent to Patients who are employed on the Estate, &c.

Tea for 100 Patients.
1 lb. Tea, 4 lbs. Sugar, 2 gallons Milk.

Cocoa for 100 Patients.
3¼ lbs. Cocoa, 3¼ lbs. Sugar, 2 gallons Milk.

Cake for 100 Patients.
2½ lbs. Sugar, 4 lbs. Dripping, and 2 lbs. Currants or ½ lb. Caraway Seed.

Extra Diets, as per Summary of Sick Lists, consist of Beef Tea, Bread. Mince Meat, Bacon, Beef Steaks, Mutton Chops, Light Puddings, Green Vegetables, Fish, Coffee, Tea, Milk, Arrowroot, Gin, Wine, Brandy, &c., &c.

Mince Meat Diets consist of 4 oz. Meat for Males, 3 oz. for Females, 1 lb. Peeled Potatoes, 1½ oz. Rice, and 3 oz. Bread each.
Pork is occasionally given on Sundays. Males, 7 oz.; Females, 6 oz.

DIETARY FOR CHILDREN.

Sanctioned by the Local Government Board on the 5th September, 1874.

Days.	Classes of Children.	Breakfast.			Dinner.													Supper.				
		Bread.	Butter, Dripping, or Treacle.	Cocoa and Milk.	Roast Mutton.	Meat.	Suet Pudding, with Treacle or Sugar.	Meat Pudding.	Meat Pie.	Hot Roast or Boiled Beef.	Irish Stew or Pea Soup.	Australian Meat and Rice, or Boiled Suet Pudding with Raisins.	Rice Pudding.	Egg Pudding with Sugar or Gravy.	Bread.	Potatoes.	Greens or other Vegetables.	Bread.	Butter, Dripping, or Treacle.	Cheese.	Milk.	Milk and Water.
		oz.	oz.	pt.	oz.	oz.	oz.	oz.	oz.	oz.	pt.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	pt.	pt.
Sunday ...	Children from 13 to 16.	B 7	$\frac{3}{4}$	1	5	...	...	...	...	...	...	...	...	...	3	8	...	7	...	1	...	$\frac{3}{4}$
Monday ...		,,	,,	,,	...	...	...	...	...	...	...	10	...	...	3	4	...	,,	$\frac{3}{4}$	...	...	,,
Tuesday ...		,,	,,	,,	...	...	...	10	...	...	...	...	...	...	...	...	8	,,	...	1	...	,,
Wednesday		,,	,,	,,	...	...	...	...	...	5	...	...	...	...	3	8	...	,,	$\frac{3}{4}$	...	...	,,
Thursday		,,	,,	,,	...	...	...	...	...	...	1	...	...	...	A3 or 6	...	...	,,	$\frac{3}{4}$	...	...	,,
Friday ...		,,	,,	,,	...	...	...	...	10	...	...	...	...	...	...	...	8	,,	...	1	...	,,
Saturday...		,,	,,	,,	...	...	16	...	...	...	...	...	...	...	...	...	...	,,	$\frac{3}{4}$	...	...	,,
Sunday ...	Children from 10 to 13.	B 6	$\frac{1}{2}$	$\frac{3}{4}$	4	...	...	...	...	...	...	...	...	...	3	8	...	6	...	$\frac{3}{4}$	...	$\frac{3}{4}$
Monday ...		,,	,,	,,	...	...	...	...	...	...	...	8	...	...	3	4	...	,,	$\frac{1}{2}$	...	...	,,
Tuesday ...		,,	,,	,,	...	...	...	8	...	...	...	...	...	...	...	...	8	,,	...	$\frac{3}{4}$	...	,,
Wednesday		,,	,,	,,	...	...	...	...	...	4	...	...	...	...	3	8	...	,,	$\frac{1}{2}$	...	...	,,
Thursday		,,	,,	,,	...	...	...	...	...	...	$\frac{3}{4}$	...	...	...	A3 or 6	...	...	,,	...	$\frac{3}{4}$	...	,,
Friday ...		,,	,,	,,	...	...	...	...	8	...	...	...	...	...	...	...	8	,,	$\frac{1}{2}$	$\frac{3}{4}$	...	,,
Saturday...		,,	,,	,,	...	...	12	...	...	...	...	...	...	...	...	...	...	,,	...	...	...	,,

DIETARY FOR CHILDREN—*continued.*

Sunday ...	CHILDREN from 7 to 10.	B6	½	¾	4	...	...	...	...	...	...	...	...	...	3	6	...	5	...	¾	...	½
Monday ...		,,	,,	,,	...	...	...	...	...	...	...	8	...	...	3	3	...	,,	½	...	...	,,
Tuesday ...		,,	,,	,,	...	...	...	8	...	...	...	...	...	...	...	...	6	,,	...	¾	...	,,
Wednesday		,,	,,	,,	...	...	...	...	...	4	...	...	...	...	3	6	...	,,	½	...	...	,,
Thursday		,,	,,	,,	...	...	...	...	...	...	¾	...	...	...	A3 or 6	...	...	,,	½	...	...	,,
Friday ...		,,	,,	,,	...	...	...	...	8	...	...	...	...	...	...	...	6	,,	...	¾	...	,,
Saturday...		,,	,,	,,	...	...	12	...	...	...	...	...	...	...	...	...	...	,,	½	...	...	,,
Sunday ...	CHILDREN from 5 to 7.	B6	½	½	3	...	...	...	...	...	...	...	...	...	2	4	...	B6	¼	...	½	...
Monday ...		,,	,,	,,	...	...	...	...	...	...	...	...	8	...	4	...	...	,,	,,	...	,,	...
Tuesday ...		,,	,,	,,	...	...	...	6	...	...	...	...	...	...	...	...	4	,,	,,	...	,,	...
Wednesday		,,	,,	,,	...	3	...	...	...	...	...	...	...	...	2	4	...	,,	,,	...	,,	...
Thursday		,,	,,	,,	...	3	...	...	...	...	...	...	4	...	2	...	...	,,	,,	...	,,	...
Friday ...		,,	,,	,,	...	...	...	...	6	...	...	...	...	...	...	...	4	,,	,,	...	,,	...
Saturday...		,,	,,	,,	...	...	...	...	...	...	...	...	8	...	4	...	...	,,	,,	...	,,	...
Sunday ...	CHILDREN under 5.	B6	½	½	3	...	...	...	...	...	...	...	...	...	2	4	...	B6	¼	...	½	...
Monday ...		,,	,,	,,	...	...	...	...	...	...	...	...	...	8	...	...	...	,,	,,	...	,,	...
Tuesday ...		,,	,,	,,	...	...	...	4	...	...	...	...	...	...	...	...	4	,,	,,	...	,,	...
Wednesday		,,	,,	,,	...	...	...	...	...	...	...	...	...	8	...	...	...	,,	,,	...	,,	...
Thursday		,,	,,	,,	...	3	...	...	...	...	...	...	8	...	2	...	...	,,	,,	...	,,	...
Friday ...		,,	,,	,,	...	...	...	...	4	...	...	...	...	...	...	...	4	,,	,,	...	,,	...
Saturday...		,,	,,	,,	...	...	...	...	...	...	...	...	...	8	...	...	...	,,	,,	...	,,	...

The Sick to be dieted as directed by the Medical Officer.

A 3 oz. of bread are given with Irish Stew, and 6 oz. with Pea Soup.

B Out of this quantity 2 oz. are given for Lunch, and Infants receive 2 oz. of their evening allowance of Bread in the afternoon.

In Summer, Rice Pudding with Sugar is substituted for Australian Meat and Rice, and Rhubarb is given with the Suet Pudding. Also only two Cheese Meals are given instead of three.

The Infants' Dietary is not limited, but varied according to circumstances.

Fish substituted for Meat every alternate Wednesday.

Dr. W. Smith's book upon workhouse dietaries and Dr. Pavey's work on dietetics give tables which show the comparative value of all articles of food; they may be usefully consulted by those who are studying this subject in detail.

Sir Lyon Playfair has also published some interesting details as to the nutritive value of flesh food, and Dr. Parkes' Hygiene gives further minute details on this subject; in these various papers the values are set out, and the dynamic value of each is shown in figures or foot tons. Dr. Pavey sets out the minimum amount required for the maintenance of human life, and shows the principles which are adopted in the prison establishments of the country for the foundation of the prison dietary. There is the Hard Labour diet, Industrial Employment, Light Labour, and Punishment diets; we do not however give these details.

The Nature of Man's Diet. Man is evidently intended by Nature to be omnivorous, but there is a proverb which is true in fact, that what is one man's meat is another man's poison. The surroundings or environment, as some are fond of styling it, must be considered when his diet is under consideration. In hot climates fruit and vegetables, with oily matters such as are found in fruits of different kinds, furnish all that is wanted. This is seen in India, where the Hindoos carry on the work of the country with a rice diet, assisted by other vegetables. They neither eat meat nor drink wine, yet their endurance under fatigue is marvellous.

But in cold climates it is impossible to get work done without nitrogenous (meat) diet and fat. In the Arctic regions whale-oil blubber of the great fish tribes, and rancid foods are relished, which in warm regions turn the stomach and cause sickness at once in those unaccustomed to their use. The Greenlanders and Icelanders eat scarcely anything else than animal food. The North American Indians live mainly on buffalo meat.

The Indians of the Pampas show another phase. They

live in the saddle, wear no clothes, and although it is very cold at night it is very hot in the day-time. They live on meat alone, frequently horse-flesh if they cannot get buffalo or beef. Their endurance is wonderful, as I have often heard from my former friend and patient, Sir Francis Head, who was never tired of telling me how he was accustomed to ride across the Pampas in company with these men, and bear fatigue, consequent upon being in the saddle for sixteen hours at a stretch, without evil result, provided he had a corresponding quantity of beef. He did not weigh it, and scarcely knew how much he put away; but he said he could not eat a tithe of it in this country.

The New Zealanders before their destruction by civilization lived entirely upon vegetables; they were a brave, hardy, well-formed and muscular set of men, and in strength were more than equal to any ordinary Englishman. The Chinese eat anything; those things which are looked at with disgust in this country are relished by John Chinaman. Dogs, cats, rats, and monkeys, with snakes and birds' nests, are all consumed, showing that there is scarcely anything in Nature which may not be food for man under special circumstances. The study of the diets of the various nations in the world is a curious one; from Japan to Tierra del Fuego there are different habits, and the food of one set is looked upon as poison by another and in some cases actually does cause severe illness. In most instances it is the cookery which makes all the difference.

Section IV.

PLAIN COOKERY.

BY

MRS. B. W. GOTHARD.

Gold Medallist in Cookery, &c.

Part I.—CHOICE OF FOOD.

The chief kinds of food are:—

1. **Animal.**—Beef, mutton, lamb, pork, venison, game and poultry, fish.

2. **Vegetable.**—Beans, peas, oats, wheat, barley, Indian corn, carrots, parsnips, turnips, cabbages, fruits, &c.

1. ANIMAL FOOD.

Beef.—*To choose good beef*—see that the grain is open, that the lean is juicy and of a rich full red colour, the fat firm (not hard), and creamy in colour. It is best when not too fat, but with an admixture here and there of fat with the lean. The lean should be of good depth from the bone. It should be tender and elastic to the touch. Beef is more tender if hung for a few days after being killed before it is cooked. *To render coarse tough meat tender*, steep it in vinegar for 20 minutes before cooking; vinegar softens the fibres and renders the toughest meat tender and delicate, whilst if it be properly wiped and dried the flavour is in no way impaired. If it is wished *to keep a joint fresh* during the hot summer and autumn days, and to prevent its being attacked by flies, brush it over thoroughly with pure acetic acid and hang it up in a draught; before cooking, wash the joint in lukewarm water and wipe dry. This will keep meat fresh for many days in the hottest weather, and is no detriment to the joint. Dr. Zoller tells us that '2 drops (not more) of disulphide of carbon allowed to

evaporate spontaneously in a closed vessel of the ordinary temperature will keep meat, fruit, vegetables, and bread perfectly fresh for several weeks,' and that 'the articles submitted to this process acquire neither smell nor taste, the carbon disulphide evaporating entirely when the foods are exposed to the air. The vapour of carbon disulphide being very inflammable, experiments should be performed in the daytime.'

Beef is not so digestible as mutton, but in the juice there are more strengthening and nourishing properties. The analysis of a piece of beefsteak proved that nearly $\frac{4}{5}$ of its weight was water, with which were mixed certain substances which formed the principal nutritious elements of the article. Thus, in 100 parts of beef we find the following analysis:—

Water	77·5
Fat	2·8
Phosphates	·1
Fibrine	12·4
Albumen	4·3
Organic extract	2·9
	100·0

In cooking, the juices must be carefully preserved.

Mutton.—*To choose mutton*—see that the grain is fine and close, that it is juicy and rich in colour, and that the fat is a dull white and firm. The lean should, like beef, be elastic to the touch, and feel tender. Southdown and Portland mutton are considered the best table mutton. The bones are small, the flesh juicy and tender. The Portland mutton owes a great deal of its good qualities to the pasturage. There are great varieties of grass found in the Dorset and Portland sheep pastures, also large numbers of very tiny snails which the sheep eat in conjunction with the grass; this latter portion of sheep diet an eminent cultivator of Portland mutton avers is the chief reason of the delicacy of this particular breed. The following is the analysis of a mutton chop:—

Water	41·2
Fat	25·1
Ossein and Phosphates ...	14·2
Fibrine	10·3
Albumen	2·1
Other substances	7·1
	100·0

Beef and Mutton, both frozen and fresh, are now imported into our country in very large quantities from Australia, New Zealand, and America. This foreign meat is much cheaper and nearly as wholesome.

Lamb is not so digestible as more full-grown meats and requires more cooking. *To select lamb*—the flesh should be juicy, firm, and much paler in colour than mutton, the bones delicate and fine, the fat firm and white. Lamb is often tested by observing the vein in the fore-quarter, which should be a bright blue. *To test if it is fresh*—pass a clean knife between the loin and the kidney; on smelling the blade any trace of taint will rapidly be discovered.

Veal, like *lamb*, requires much cooking to render it digestible. The flesh of good veal is smooth, juicy, and of a red colour. Very white and puffy veal shows that the calf has undergone great torture and cruelty by being bled slowly. This ought never to be purchased by humane people. *Veal*, like *lamb*, should be cooked whilst it is freshly killed; if stale, it quickly changes colour, feels clammy, and has a faint, sickly, unwholesome smell.

Pork is a meat which ought to be purchased and used with the greatest caution. *Trichina* are present in a great deal of pork. It has been found that cooking hardly kills them, and if once taken into the body there is no cure for these detestable flesh parasites. Pork is not so nutritious as beef or mutton and requires a greater amount of cooking. Never buy pork with a dark, clammy skin. If it is used at all, it should

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be delicate, tender, and juicy, with not too great a proportion of fat, the rind thin, the fat firm and white.

Ham (and **Bacon**) is closely allied to pork. It is a universal household resource, and the chief of dried and salted meats. The following analysis of a slice of bacon will give the student some idea of its component parts, taking the various percentages as—

Water	24·6
Fat, chiefly Oleine	58·3
Fibrine	7·2
Albumen	2·8
Salt	5·1
Other Matter	2·0
	100·0

Poultry may be classed in this descriptive and analytical catalogue of meats. *Poultry dealers generally judge* by the beak of the birds, the spur, legs, and breast bone. The lower portion of the beaks of game and poultry when young are soft and pliable, the spur hardly formed, the legs and comb smooth, the skin thin. The flesh of fowls having black legs is, as a rule, whitest when cooked. *Geese and ducks may be tested* by the lower part of the bill being pliable, the feet smooth, bright in colour and limber, *i.e.*, easily bent to and fro. An old turkey has rough scales on the legs, callosities on the soles of the feet, the claws strong and long. In the male bird, when young, the tuft on the breast is just sprouting, the wattles on the neck small, feet smooth, and bill tender.

Fish ranks next to beef. The herring is very valuable as an article of nutriment. The idea that eels, herrings, and mackerel are not nutritious or suitable as flesh foods has had its day, and careful analysis proves the new theory correct, and the old ideas the remnant of an exploded theory. It has been shown in an article in *Blackwood's Magazine* that herrings are richer in nitrogen than beef, also that 'fish-eaters are spare, sinewy,

and strong, and free from those mountains of flesh and masses of blubber which characterise the prosperous beef-eater.' Perhaps this is not as elegantly expressed as it might have been, but it conveys a good deal of truth. There is not the slightest doubt of the highly nutritious character, the easy digestibility, and the immense value of fish above many kinds of flesh foods. The coarser kinds of fish are, fortunately for the poor, richer in nourishment than those which we frequently meet with at the tables of their richer brethren. Skate, conger eel, dabs, haddock, plaice, together with herrings, are among the cheapest fish, but they are popular and good articles of diet. A recent analysis of a skate gave the following returns:—

Water	64·3
Fat	2·7
Fibrine	19·1
Albumen	7·4
Gelatine and other matters ...	6·5
	100·0

Shellfish, such as crabs, crayfish, lobsters, whelks, mussels, &c., are very often indigestible. Unlike their cousin, the land snail, a clean-feeding creature, the sea crustacea are coarse feeders, not over particular in the kind of diet they indulge in. Still they have been pronounced good brain-feeders by some scientific men, and until some new theory is started we are bound to believe them. Oysters are very nutritious and easily digested, because of the pepsine (similar to gastric juice) in their composition. Many persons who cannot eat uncooked oysters can take them scalloped, though they are then less easy of digestion. Invalids should have them without beard, gills, and the hard muscle attaching to the shell.

2. VEGETABLE FOODS.

Vegetable foods now claim the attention of the student. The most highly nitrogenous vegetable foods are dried haricot

beans, peas, oats, whole wheaten meal, barley, Indian corn, &c. The following table of the average comparative value of dried foods, compiled from my own recent analyses, may be found useful to the student:

Component Parts	Beans	Peas	Oats	Whole Wheaten Meal	Barley	Indian Corn	Rice
Nitrogenous Matter ...	33·0	24·5	24·2	21·3	14·6	9·5	15·0
Carbonaceous Matter ...	48·0	58·2	62·3	60·2	68·4	78·2	72·7
Mineral and other Matter.	5·2	3·2	5·1	10·4	4·2	4·3	1·5
Water	13·8	14·1	8·4	8·1	12·3	8·0	10·8
Total	100·0	100·0	100·0	100·0	100·0	100·0	100·0

These foods, if properly prepared and eaten with certain proportions of oils and fats, form excellent substitutes for meat.

Dried vegetables are far less used by people of all classes than they ought to be; less meat and more of this vegetable diet ought to be introduced, not alone on account of the economy, but for health's sake. In fact, the nitrogenous qualities of beans, peas, and oatmeal are far greater than those of meat, whilst the cost is widely different.

Vegetables, such as the potato, parsnip, carrot, onion, cabbage, turnip, and marrow or gourd plants, are very useful, especially some of the first named. *The potato is a valuable antiscorbutic.* Since its introduction into England, and by the more constant use of vegetables, that dire disease, leprosy, has disappeared; and, no doubt if they were more freely used now, many skin diseases and some kinds of consumption, which are but forms of scrofula on the lungs, would also gradually die out.

Component Parts	Snow flake Potato	Carrot, Long Red	Parsnip	Onion	White Cabb'ge	Turnip	Marrow
Albuminoids	8·6	4·3	6·8	4·2	2·4	1·4	1·2
Carbonaceous Matter ...	13·1	5·0	10·5	8·5	6·3	2·0	2·4
Mineral and other Matter.	3·3	10·5	8·5	·5	7·1	·6	2·0
Water	75·0	80·2	74·2	86·8	84·2	96·0	94·4
Total	100·0	100·0	100·0	100·0	100·0	100·0	100·0

Besides the vegetables in general use, there are many kinds of vegetable products which are almost neglected, or used only by the poor, which are not only nourishing, but excellent for the blood. For instance, nettle tops, turnip greens, wood sorrel, the broad-leaved sorrel, young birch leaves, the young leaves of the dock, and ribbon grass, etc., all forming dishes, when cooked, more or less nutritious, and most of them costing little except the trouble of gathering.

Of fruits, berries, and nuts, as they belong to the vegetable kingdom, a short average analysis may prove interesting:

Component Parts	Apple	Orange	Peach	Pear	Goose-berry	Straw-berry
Albumen	3·0	2·5	1·2	2·8	1·3	·5
Carbonaceous Matter	12·0	11·0	9·0	14·1	7·5	1·2
Mineral and other Matter. ...	3·6	1·4	3·4	4·0	2·0	2·0
Acids	4·0	5·0	5·1	1·0	5·2	5·0
Water	77·4	80·1	81·3	78·1	84·0	91·3
Total	100·0	100 0	100·0	100·0	100·0	100·0

Component Parts	Figs	Dates	Bananas	Filberts	Cocoa-nuts
Albuminoids	8·0	9·5	10·0	6·0	9·0
Carbonaceous Matter ...	64·4	60·3	39·1	54·2	51·2
Mineral and other Matter.	5·2	7·8	3·7	4·1	1·3
Water	22·4	22·4	47·2	35·7	38·5
Total	100·0	100·0	100·0	100·0	100·0

It will be seen by these analysis of fruits that they are invaluable in summer, as supplying liquid combined with nutriment.

Seasons for Meat, Fish, Poultry, Vegetables, &c.

MEATS.

Beef ....All the year round

Mutton .... do. do.

Veal can be obtained all the year round. In perfection May to September

Pork..................October to April

House Lamb............December to February

Grass Lamb ...... March to August

Kid........................April to July

Buck Venison ... July to September

Doe Venison, October to December

FISH.

Brill ...... September to November
Cod .... October to April
Codlings ......December to January
Carp ....October to June
Dory..................February to July
Dabs ....December to May
Eels .... October to April
Flounders .... January to April
Gurnet .... November to May
Gudgeon...September to December
Herrings ...... March to September
Haddock .... All the year round
Lamprey .... January to May
Mackerel............... March to July
Mullets ...... January to September
Plaice...............December to May
Perch ....August to June
Pike.................. October to April
Soles............... All the year round
Skate........... November to March
Sprats......... November to January
Smelts .... October to May
Sturgeon, all the year round. February to June in perfection
Salmon, Scotch, January to August
Do. Irish ...... January to July
Do. Severn...December to June
Do. Tweed...February to Sept.
Trout (Salmon), Perth ... May to July
Trout (Salmon), North Scotland... June to July
Trout (Salmon), Tweed ... January to June
Turbot, all the year round. Best October to April
Trout, River...... .. May to August
Tench .... October to April
Whitebait .... April to July
Whiting .... All the year round

SHELL FISH.

Crabs .... January to April
Cray Fish ... January to December
Cockles ... September to November
Lobsters .... All the year round
Mussels .... September to April
Oysters ....August to April
Prawns .... January to July
Shrimps............All the year round

POULTRY.

Chickens .... All the year round
Capons............ do. do.
Ducks .... April to December
Ducklings ....April to June
Fowls .... All the year round
Geese......... September to January
Green Geese ...... March to August
Larks........ ... December to March
Pigeons ....March to September
Quails ....May to July
Turkeys......... December to March

GAME, ETC.

Blackcock ... October to December
Duck (Wild), September to January
Leverets ...... March to September
Grouse .... August to February
Hare ....September to March
Ortolans......December to February
Partridges ......September to March
Pheasants ....October to March
Rabbits (tame) ... February to June
Do. (wild)......July to February
Snipes ....November to January
Teal ....September to February
Widgeon ... September to February
Woodcock, November to December

VEGETABLES.

Asparagus .... March to July
Artichokes ...... June to September
Do. Jerusalem...Nov. to April
Beetroot .... January to June
Beans (French)......June to August
Do. (Scarlet runners)......June to September
Beans (Windsor) ...... June to Sept.
Brocoli............... October to April
Brussels Sprouts ...... November to February
Cabbage .... All the year round
Carrots............ do. do.
Cardoons......November to January
Cauliflower ....March to July
Celery .... September to June
Cucumbers ...... April to September
Cress............ March to September
Endive .... March to November
Greens .... October to March
Haricot Beans ...All the year round
Leeks .... May to November
Mushrooms ...... All the year round
Do. (Field), Sept. to October
Mustard (for Salads) March to Sept.
Nettles..................March to May
Onions ....All the year round
Do. (Spring)......March to Sept.
Potatoes, New .... April to July
Pumpkins .... August to March
Do. ....All the year round
Parsnips............October to March
Peas...............April to September
Do. (Dried)......All the year round
Radishes ...... March to September
Spinach............November to July
Sorrel .... June to September
Salsify... ....July to August
Scotch Kale......November to April
Sea Do. ...... February to October
Salads (Lettuces) ...March to Sept.
Shalots ....March to September
Turnips .... May to July
Do. Tops ... February to April
Truffles.........August to November
Tomatoes.........August to October
Vegetable Marrow ... June to Sept.
Watercress......March to December

HERBS.

Herbs.	When in Season.	When to Dry.
Basil	May to September	August
Burnet	May to September	July
Bay Leaves	All the year round.	
Chervil	January to September	July
Celery Leaves	September to June	Winter
Elderflowers	May to June	Early June
Garlic	March to September	September
Fennel	March to August	July
Marjoram	May to September	July
Mint	April to September	July
Parsley	All the year round	July
Peppermint	May to September	August
Sage	All the year round	September

HERBS—*continued.*

Herbs.	When in Season.	When to Dry.
Savoury	May to August	August
Tarragon	January to September	August
Thyme	May to September	July

FRUITS, ETC.

Apples	All the year round
Apricots	June to September
Barberries	July to October
Bilberries	August to October
Blackberries	July to October
Bananas	October to February
Cherries	July to September
Currants	June to September
Cranberries	July to October
Citron	August to December
Cocoa-nuts	August to January
Cob-nuts	October to November
Chestnuts	October to December
Damsons	August to November
Dewberries	August to October
Dates	August to January
Elderberries	August to September
Figs	All the year round
Filberts	August to November
Gooseberries	June to September
Greengages	July to September
Grapes	November to April
Hazel Nuts	All the year round
Lemons	October to May
Limes	May to January
Melons	July to September
Medlars	July to October
Mulberries	July to September
Nectarines	June to September
Oranges	October to June
Pears	June to October
Peaches	July to September
Plums	July to October
Pine Apples	September to July
Prunes	All the year round
Raspberries	July to August
Rhubarb	January to June
Raisins	All the year round
Strawberries	June to September
Walnuts	July to December
Do. Green	May to June

Part II.—PREPARATION OF FOOD.

Food may be prepared by the processes of roasting, baking, grilling, frying, boiling, steaming, and stewing.

The object of cooking is to change into wholesome nourishment substances that would otherwise be useless.

The great art of cooking is not to allow any of the good things to get out and be wasted during the cooking, and to make the food tender, so that the teeth can grind it and make it digestible.

Such methods of cooking must be adopted as will be most economical. Food must be cooked at the right heat (use of thermometer and economy of gentle cooking). A correct knowledge of the time required to cook the various kinds of food is necessary, as also the exact effect of the cooking on the different constituents of which the food is composed.

1. **Roasting** is one of the most easy and wholesome ways of preparing meat. The sudden application of heat hardens the albumen of the outer portion, and so prevents the escape of the nutritious parts.

Roasting is most suitable to large and fleshy joints. If small joints be roasted they will probably be hardened and too much reduced. Neither is this method suitable for the more sinewy pieces, as it will not extract all the nutritive qualities.

Method of Roasting.—Have a clear fire towards the front bars of the grate. Pull the coal forward on the top from the back to the front with a shovel; add all fresh fuel at the back of the fire, and when you poke the fire do so at the *bottom* of the grate. Brush the grate and hobs. Place the hastener before the fire, and get the jack in order. If you have no hastener spread a cloth over the backs of two or three chairs to keep in the heat and prevent the cold draught rushing directly on to the meat. The want of a jack may be supplied

by a long nail driven into the mantelpiece, a number of threads of worsted twisted together, and a hook fastened at the bottom, with a dripping-pan placed under. The joint should be placed very near the fire at first, and when the albumen is hardened should be drawn back a little and allowed to cook more slowly. N.B.—Should you require to poke the fire whilst any meat is roasting, always turn the hastener round, so that the dust does not fly up and rest on the meat, or the ashes and cinders fall into the dripping-pan.

2. **Baking.**—This process is similar to roasting, the meat being placed in an oven instead of before the open fire. Formerly ovens were not constructed with proper openings for the escape of steam and the odours from burnt fat; under such circumstances the meat would be spoiled in flavour, and often insipid and sodden. In the more modern ovens, with careful heating of the same, baked meat may not be distinguished from that which is roasted.

Method of Baking.—Many a good joint is spoilt by being put into a cool oven when it ought to have been kept out a few minutes longer, and the oven allowed to get properly hot. Putting meat into a half-warm oven causes it to be flabby, tasteless, dry and insipid; there is no crispness about it, and the juices, which ought to have been found in the meat, are found in the dripping-tin. It is invariably the sign of bad cookery when any of the *juices* of the meat are allowed to escape. The dripping-tin, too, ought to be large enough to *contain* and *receive* all the fat likely to exude from the meat in the process of baking. Let the oven be *very hot*, and then place the meat in it; about three minutes after it has been in, push in the dampers, so as to moderate the heat, and let it bake more slowly.

In most towns people may take their dinners to the bake-house, where for a small amount they may have meat, bread and pudding baked, and so save the time and fuel.

About the same time is required for baking as roasting.

By sprinkling a little flour on the oven-shelf *you may tell the heat.* If too hot, the flour will immediately burn; if it browns quickly that will do for pastry and meat; if it change colour slowly then the oven will only do for milk puddings and stewing.

3. **Broiling.**—This also resembles roasting in its results, but is only suitable for chops and steaks, and these only when tender. Some kinds of fish are grilled or broiled.

Mode of Broiling.—This must be done over a clear fire. The gridiron ought to be kept scrupulously clean, and never put away dirty; a silver gridiron is considered the best, but it can only be had in the houses of the rich, in first-class hotels, and restaurants. Take the gridiron, place it over the fire to heat a little, rub the bars over with suet or a buttered paper, and place the meat on the grid; turn it every two or three minutes, so that none of the red juices escape. The process is simple, but it requires care and attention, together with the exercise of a little common sense. For instance, the grid should be put rather slantingly over the fire, so that the fat from the chops, or other meat, may not fall into the fire, and thus create, not only a smell of burning grease in the house, but make a flame rise which will cause the outside of the meat to have a charred, blackened appearance, and to taste of cinders and grease. Again, in broiling fish, such as Red Mullet, it is usual to wrap them in buttered paper, and to slightly chalk the bars of the grid. Never turn or lift any meat which is cooking, especially when broiling or grilling, by sticking a fork into it; use a skewer, or better, a pair of steak tongs, and, if it must be pierced, let the insertion be in the fat portion of the meat, and there will be then no great waste of nutriment.

4. **Frying.**—This is a subject which, a few years ago, was very little understood, but the art is reviving amongst the people, and we have fried-fish shops in London and the provinces, where the poor man can, for a halfpenny, obtain a little piece of fried fish as well cooked as in any German, French, or American town, and infinitely superior to the fried

fish one often meets with in houses which boast of a 'Good *plain* Cook.'

Mode of Frying.—*In frying fish*, or similarly cooking any article of diet, it is proper to use a frying kettle, or sautè pan, which is nothing more nor less than a *large deep stewpan*, oval or round, as the case may be, and according to the requirements of the family. For all general purposes an eight-inch wide stew-pan, at a cost of 2s. 6d., is sufficient, and a wire frying-basket to match, at 1s. 3d.; the meshes not being too fine, or the wire too heavy and coarse. Into the frying-kettle is put about 2 lbs. of good dripping (bought lard should be avoided), which is suitable for all ordinary purposes. Oil may be used where it is preferred; indeed, food cooked in oil is most wholesome, has a finer flavour, and is more crisp. Oil can attain a greater degree of heat without burning than any other known fat, therefore it can be made hotter before the article to be cooked is placed in it. The amount of oil or dripping used need not be an expensive item, as by clarifying it occasionally and taking care not to allow it to burn it may be used several times.

The ordinary frying-pan is suitable for pancakes, liver, and bacon, and for warming up cold vegetables, &c.

Cutlets and chops covered with egg and bread-crumbs and then fried are tender and easy of digestion, because the egg quickly forms a hard cover and prevents the juices leaving the meat.

5. **Boiling.**—Food, to be nutritious, must be juicy, tender, and easily digested. There are more failures in boiling meat, perhaps, than any other method of cooking; and simply because people do not care to study the science, if I may so term it, of cause and effect. Put meat into a saucepan with cold water, apply heat to it, and you will find the juice gradually drawn out into the water, instead of being retained in the meat; let the liquid in the saucepan boil fast for an hour or so, and then examine the meat. It will be hard and horny almost in texture,

the result of too great a force of long-continued heat, which has hardened the albumen in the juices and rendered the fibrine a dense indigestible mass of animal matter.

Mode of Boiling.—Now, to prepare food for table, whether it be 'Fish, flesh, or fowl,' remember the great object in view, and think of the chemical work your cookery is to begin, viz., the process of digestion, and assist it as much as possible. First, see that the pot in which you are to boil the meat is thoroughly bright and clean. Second, that the fire is clear, not heavy, dull or smoky. Fill the pot $\frac{3}{4}$-full of water, put it on the fire, and let it come to the boil. Now, if that boiling water in the pot were to be spilt over your hand by accident, you would find that the pores of the skin contracted, the skin thickened, and the serum, a white juice of the body, would collect under it, having no means of escape ; so if you plunge the meat into boiling water, a case of contracted skin is formed round it, preventing the escape of the juices, the most valuable portion of the meat. Having put the meat into the boiling water, let it boil up quickly for two or three minutes; then draw the saucepan to one side and let it *boil gently*—not exactly *simmer;* a rather more forcible movement of the water is required, allowing the same time per lb. for butcher's meat as for roasting, *i.e.*, $\frac{1}{4}$ hour to the lb., a quarter over where the joint is under 10 lbs. A superior method of treating meat to that of boiling, is by the use of Capt. Warren's patent cooking-pot, which any one who is possessed of any intelligence can use, although it is often put on one side and mismanaged by careless, idle, or ignorant people who try it.

6. **Stewing.**—This method of cooking is undoubtedly the least wasteful. No part of the meat is destroyed, and pieces that cannot be utilized by the foregoing processes may be stewed until tender and palatable. The meat to be stewed ought to be placed in a small quantity of water in an earthenware stew-jar, or a proper stew-pan, and put into a slow oven, or by the side of the fire; but it must stew *very gently* until

done. The principal part of the stewing ought to be done the day before it is wanted, in order that by getting cold all fat can be removed. The French keep their stew-pan or *pot-au feu* constantly in use, putting into it all sinewy pieces of meat, vegetable trimmings and other scraps often rejected by us.

Stewing cannot be too highly recommended and encouraged among the poorer classes. Little fire is required, as great heat would be unsuitable. Much time and work is saved, because a stew will prepare gently by itself for hours. It is economical, extracting nourishment even from bones, and by the addition of vegetables, rice, flavourings and seasonings, many excellent and savoury dishes may be obtained.

7. **Steaming** is effected by placing the article to be cooked in a vessel (called a steamer) which has holes in the bottom. This is tightly fitted over a saucepan in which is boiling water, and the steam ascending into the upper vessel cooks the meat, &c. By this means none of the food mixes with the water, but more time is required than in boiling. It is an excellent way of cooking potatoes, batter puddings, and young poultry, as it preserves them whole when often they would break, and in the case of the pudding there is less danger of the egg curdling than in boiling water.

On Stock-making and Soups.—Stock is the foundation of all soups and gravies. All liquor in which meat is boiled should be put into the stock-pot; Papin's Digester, as a stock-pot, is one of the most useful purchases a housewife can make, also a bone-crushing machine. All bones that come into the house, whether butcher's meat, ham, or fowl, should be crushed or broken with a hammer and put into the stock-pot, and boiled, or stewed rather, from *morning* till *night*, when it should be strained off, and the pot filled with cold water, and scoured out next day, before putting the stock back or making fresh. If the stock is permitted to remain in the pot all night, with the lid on, it will turn sour, and, even if the lid is off, it will acquire a taste of metal anything but pleasant. On putting the liquor from

meat, with any bones, spare pieces of meat, &c., into the stock-pot, fill it up with water. Peel a turnip, scrape and wash a carrot, a small piece of the outer stalks of celery (or dried celery leaves or seed), and a bunch of sweet herbs (thyme, parsley, marjoram, or bay-leaves). Let the water come slowly to the boil, skim carefully, and, when it is just on the point of boiling, add 1 teaspoonful of salt, which will assist the scum to rise, clear it all off, and then put in the vegetables and spices, such as whole pepper, &c. Fasten the lid on the Digester, looking at the soup every couple of hours or more, and taking off the fat. Any kind of wholesome every-day soup may be made from such stock, also good gravies. Remember that in this process the very opposite results are required when boiling meat for table: the juices of meat are required to be extracted. Special kinds of soups will be found in the recipes.

Part III.—RECEIPTS, &c., SUITABLE FOR ARTIZAN COOKERY.

Apples (Pyrus-Malus).—An agreeable, healthy fruit of the rose order. It contains malic acid and phosphorus in large quantities. The apple is useful as an article of diet, either in a cooked or uncooked state.

1. *Apples, Baked.*—Select the apples of uniform size, put them into a tin or pie-dish and place in a moderate oven, where they can receive a slow but regular supply of heat. Apples must not be too quickly baked. It is better that they should be some two hours in cooking than done in twenty minutes, and all the goodness, in the shape of the phosphorus and essential oils, permitted to escape through the too great force of heat, turning the moisture in the fruit to too great a bulk of steam, causing the apple to burst, and the valuable portions to be lost. When sufficiently tender, place on a clean dish, and grate one lump of loaf sugar over them. This is an excellent supper for children, given in conjunction with a slice of brown bread (or, better still, whole-meal bread) and a cup of milk (skim or fresh).

2. *Apple Snowballs.*—Wash and pick $\frac{1}{4}$ lb. of rice, put it into a saucepan with one pint of skim milk or water, one teaspoonful of moist sugar, and a small piece of lemon-rind. Place the pan near the edge of the hob, so that the rice may swell slowly. When the rice has absorbed all the milk, remove the lemon-peel and have ready peeled and cored four ordinary sized apples. Dip a clean pudding-cloth in clean water and wring it out, dust it over with flour, spread a ring of rice, sufficiently to cover the apple, stand the apple on the rice, and tie that portion of the cloth up. If the cloth is a large one, the

four apples may be tied up in the four corners. Plunge into a pot of boiling water, and boil for an hour-and-a-half. Serve with moist sugar.

3. *Apples and Rice.*—Prepare 2 oz. of rice and ½ pint of milk as above directed in No. 2; peel, core, and slice six apples. Lay them in a quart basin with a little lemon-peel, one tablespoonful of moist sugar, and a little nutmeg, or one or two cloves, according to taste. When the milk is absorbed by the rice in the saucepan, remove the peel and lay it into the basin, flour a cloth, and tie over; boil for two hours. This is a cheap and digestible summer dinner for children, far superior to using rich pastry, and it makes an excellent change.

4. *Apple Dumplings.*—Pare and scoop out the core of three apples, fill the centre with one clove and moist sugar, and then make the following paste: put into a basin ½ lb. of flour, rub into it 3 oz. of dripping, and when the lumps are all lightly rubbed into the flour, mix with it one teaspoonful of Borwick's baking-powder, and mix it well with the flour; then mix with the contents of the basin sufficient tepid water to make it into a light dough. Flour the paste-board, and, placing the dough on it, roll out, double it into three, give it another quick, even, regular roll, then cut it out into three parts. Place an apple in each of the pieces, wet the edges, and roll round the apple, shaping into a ball with the hands, flour or grease a tin, and put them into it. Bake in a moderate oven for half-an-hour, or the dumpling may be boiled, first tying them up in floured cloths, and then placing them in a saucepan with plenty of boiling water.

5. *Apple Pudding.*—Line a basin, after greasing it, with paste made as directed in No. 4; peel, cut up, and core six apples. Put the cores and peels into a small saucepan with 1 table-spoonful of sugar, and 1 breakfast-cupful of water; let it boil for ten minutes or a quarter of an hour. In the meantime, slice the apples; also mince very finely ½ oz. candied orange-peel. Add 1 oz. of moist sugar, ½ teaspoonful of ginger, and

mix with the apples in the basin. Strain the liquor, which is boiling in the small saucepan, into the pudding; cover with paste, tie a floured cloth over; place in boiling water, and let it boil an hour and a half or two hours.

6. *Apple Tart.*—Rub into 1 lb. of flour 6 oz. of dripping; add 2 lumps of white sugar grated; mix into a paste with a knife, and roll out three times. Line the edge of the pie-dish with a strip of paste. Prepare 8 or 10 apples, as in No. 5, *remembering to make the syrup from the boiled rinds and cores*, for in these two portions of the apple lie some of its best qualities and essential properties, which are too often wasted in English households, but which every Scotch housewife economises and knows the value of. Lay in the bottom of your pie-dish 2 laurel or peach leaves. Pile the apples up in the dish, making them quite high and dome-shaped. Put the sugar in the middle of the pie, so as it may not burn at the bottom of the dish or render the paste sodden by melting; brush the strips of paste over with water, roll out, and cover with the rest of the paste. Trim by taking the dish in your left hand, and a sharp knife in the right; cut in an opposite direction from yourself in trimming the tart. Crimp the edge with a knife, brush over with milk—do not make it sloppy, but just damp. Grate 1 lump of sugar over, and bake in a quick oven for half an hour.

7. *Apple Pudding, Baked.*—Put into a basin ¼ lb. stale crusts, broken up small, pour over them one pint skim milk; let them soak an hour, and beat up with a fork, add one table-spoonful of sugar, and two of minced suet, with ½ lb. chopped apples, and one egg; grease a tin pie-dish, put the mixture in, bake one hour in a moderate oven, and serve with the following sauce:—Put the peel and cores into a saucepan, with sugar and water, as before directed in No. 5; when it has boiled a quarter of an hour, strain and put it back into the saucepan. Mix a tablespoonful of Johnston's corn-flour with one teacupful of milk; when the syrup in the pan boils, stir it in, add more

milk if necessary; boil ten minutes, put into a basin or sauce-boat, and serve with the pudding.

8. *Apple Pudding.*—Grate 6 oz. bread crumbs; pare, core, and slice 6 ozs. of apples, well grease a tin pie-dish, strew bread-crumbs over the bottom and sides of the dish, cut a thin slice of bread and lay in the bottom of the dish; over the strewing of crumbs put a layer of apples, and grate some nutmeg, and strew one tablespoonful of sugar over the apples; next, a layer of bread-crumbs; then apples as before, finishing with crumbs. Mix one egg well beaten up with half-pint of skim milk, pour over the pudding, put a little bit of dripping on the top, and put it into a hot oven, and bake three-quarters of an hour. Turn out on to a clean hot dish.

9. *Apples and Rice, Baked.*—Prepare the rice as in No. 2, grease a pie-dish, put alternate layers of prepared rice and apples till the pie-dish is $\frac{3}{4}$ full, pour over it a custard of one egg beaten up, and half a pint of milk; put a small piece of dripping on the top, grate a little nutmeg over the top, and bake one hour in a moderate oven.

10. *Apple Cake* (Yorkshire farm receipt).—Cover a plate with some nice flaky paste. Peel, core, and slice one or two apples in very fine shreds or slices, place them on the paste, strew one tablespoonful of moist sugar over, grate about a quarter of a teaspoonful of ginger, break a piece of butter the size of a walnut into little pieces and put here and there over the apples, put paste on the top, clip the paste round the edge with a pair of scissors as a decoration, bake in the oven for half an hour, and when taken out grate one lump of sugar over. The round is generally cut into eight or ten pieces, and is eaten hot or cold.

11. *Apple Cake* (Hampshire receipt).—Put 1 lb. of flour into a large basin, rub 4 oz. of dripping into the flour, peel and core 1 lb. of apples, slice them into thin small slices, grate some nutmegs, and add a little spice (about one teaspoonful in all), and two tablespoonsful of sugar with a teaspoonful of

baking powder, mix with the flour, then take sufficient cold water to make it into a dough, grease a tin pie-dish or baking-tin, and bake in the oven for one and a half or two hours.

12. *Apples, Stewed.*—Take six or eight eating apples, peel and core them carefully, fill the centre where the cores have been withdrawn. Put them into a stewpan with six cloves and a bit of nutmeg as large as a pea, and a little bit of either lemon or orange rind, one tablespoonful of sugar, also three teaspoonsful of water, boil till the apples are tender, lift them out on to a clean dish, reduce the syrup to about one cupful and strain over the apples.

13. *Apple Fool.*—Pare six nice cooking apples, put them into a saucepan with a lemon-rind and two tablespoonsful of sugar, also one teacupful of water, put them through a wire sieve when sufficiently cooked. Add to this one cupful of new milk. This is nice for children's tea or supper.

14. *Apple and Batter Pudding.*—Peel, core, and cut in two four baking apples, place them in a greased baking-tin, put in a basin two tablespoonsful of flour, drop in an egg, mix it into a smooth batter with one pint of milk and pour over the apples, bake in quick oven for three quarters of an hour, strew sugar over, and serve hot.

15. *Apple Roley-Poley.*—Chop a quarter of a pound of suet very finely, and mix with 1 lb. of flour; add a pinch of salt and half a teaspoonful of baking-powder. Mix this into a paste; roll it out the width, length, and thickness you require for the pudding. Cut some peeled apples into very thin transparent slices, lay them over the paste, strew sugar over, and add one or two drops of lemon juice. Roll the pudding up, tie in a floured cloth, and plunge it into boiling water. Let it boil about $1\frac{1}{2}$ hours. Serve with *thickened milk:* 1 tablespoonful of flour, mixed with 2 tablespoonsful of cold water. Put on the fire a saucepan, with half a pint of milk and 1 dessertspoonful of moist sugar. As soon as the milk appears to rise in the saucepan, pour in the batter; stir till the milk

thickens; let it boil for three minutes to cook the flour; flavour with lemon, if you have any rind by you: put into a sauceboat or basin, and serve with the pudding.

16. *Apple Black Cap.*—Wipe carefully six or eight little apples, remove the stalks, and place the apples in a greased baking-dish. Prepare a batter of four tablespoonsful of flour, mix by degrees with 1 pint of milk, add a tiny pinch of salt, and 1 teaspoonful of baking-powder; beat this up lightly, pour over the apples, and bake till it is brown on the top. Serve with sugar. This is an economical dish; but it must be eaten hot, and not be overbaked.

17. *Apple and Bread Pudding.*—Grease a pie-dish; put in slices of bread, slices of apples, and fat scraps or chopped suet, and sugar to taste, in rows or layers, until the pie-dish is three parts full. Pour over enough milk to fill the pie-dish. Bake in a moderate oven for one hour. Excellent dinner for children.

18. *Apple Marmalade.*—When apples are cheap, this is one of the nicest jams that the cottager's wife can make. Pare and core 7 lbs. of 'windfalls,' cutting out any portions that are much bruised; cut them in halves, and put into a clean saucepan, with water enough to cover them; boil until they are tender, and then empty them into a basin. Take weight for weight with the apples, of Demerara sugar; put it into the saucepan, with about 1 pint of cold water; let it boil (skimming it carefully) till it is quite clear-looking; then add the apples and the juice of three lemons (add thin strips of the rinds also, if you like it). Boil for half an hour, till it jellies. Put into jars, and tie down with three or four thicknesses of brown paper.

19. *Apple Sauce.*—Pare, core, and slice six apples; put them into a saucepan, with half an ounce of butter, 1 oz. moist sugar, a quarter of a teaspoonful of grated nutmeg, and 1 teacupful of cold water. Boil till the apples are reduced to a pulp; if they do not fall well, pass them through a wire sieve.

This sauce is eaten to Roast or Baked Goose, Duck, Pork, Irish Goose, &c.

20. *Apple Custard* (German).—Grease a pie-dish; pare, core, and slice in fine thin slices 2 apples; put them into the pie-dish with a tablespoonful of sugar over and the juice from the boiled skins and cores. Place the pie-dish in a hot oven for quarter of an hour or less; if the oven is very hot, until the apples are tender. Beat up 1 egg with 1 pint of milk; flavour and sweeten to taste, then pour over the apples and bake for three quarters of an hour at a moderate heat.

21. *Apple Custard à la Watronsville* (American).—Pare the apples, grease a pudding-basin, slice the apples into it till it is about a quarter full; break two eggs into a basin, with 1 tablespoonful of sugar and a few drops of lemon essence, whisk them up and add sufficient milk to fill the pudding-basin to within half an inch of the top. Butter a piece of wrapping paper and put it over the top of the basin. Place the basin in a saucepan, with sufficient boiling water to come within one inch from the top of the basin. Let it boil very slowly, in fact only simmer, for $1\frac{1}{2}$ hours. If the pudding boils fast it will be quite like a honeycomb, and unfit to come to table.

22. *Apple-water.*—Slice a large, tart, cooking apple (without peeling it), also a small portion of the rind of a lemon. Put all into a saucepan, with six lumps of sugar and $1\frac{1}{2}$ pints of cold water. Let it come *slowly* to nearly boiling point; draw it back from the fire, and let it simmer slowly for a quarter of an hour; strain into a jug. Useful during fevers, or for a summer beverage.

23. *Apple Tea.*—Slice apples (after peeling and coring) into a jug, also slice up half a lemon, first taking out the pips, add sugar to taste; pour 1 pint of boiling water on this and let it stand until cold. This makes a pleasant drink, little inferior to lemonade, but it is not so valuable from a medical point of view, as the rind of apple contains some valuable properties which are extracted by the process described in No. 22.

24. *Apple Whip* (German).—Peel and grate 3 large apples, add to them a quarter of a teaspoonful of mixed spice, and 1 tablespoonful of moist sugar. Take a spoon or fork of white metal (do not use steel) and whip it well up, add 3 tablespoonsful of bread crumbs passed through the wire sieve, whip the whole up, pile on a plate, and serve with new milk or custard.

25. *Apple and Sago Pudding.*—Use the large sago. Take 2 oz. of the sago, and swell it in a saucepan over the fire in ½ pint of milk. Pare, core, and slice 2 large-sized apples, put them into the oven, as in No. 20, till tender, then take the sago off the fire, when it has absorbed the milk. Beat up 1 egg with 1 pint of milk, mix with the sago, and add half teaspoonful grated ginger. When the apples are tender mix all up together, and put back into the pie-dish; bake for half an hour.

26. *Apples and Tapioca.*—Take 1 oz. of tapioca, crush it, and put it in one pint of cold water, and let it soak for five or six hours; then put it on the fire to swell it, as for sago, No. 25, stirring it, so that it may not burn; pare 4 apples, take the cores out, stick a clove in each cavity, and fill up with sugar, lay them in a pie-dish, sweeten the tapioca, flavour with 2 or 3 drops of lemon essence, mix with 1 egg and 1 pint of milk, pour over the apples, and bake for one and a-half hours.

27. **Arrowroot.**—A starch or carbonaceous food obtained from the root of certain foreign plants. West Indian Arrowroot is obtained from *Maranta Arundinacea*, East Indian Arrowroot from the *Curcuma leucorhiza*. A starch from the potato is very frequently sold instead of the pure arrowroot. In nearly every case Johnston's corn-flour will answer as well as arrowroot. Arrowroot is also adulterated with sago meal. *To test if the arrowroot is pure*—take a pinch between the finger and thumb; if it makes a sort of crackling sound, it is pure. The roots of the M. Arundinacea are about one foot long, white and jointed, with a thin, filmy scale-like covering. It is chiefly used for invalids, and is too dear for every-day use in houses where economy is a point to be observed.

28. *Arrowroot for the Sick.*—Take 1 tablespoonful of arrowroot in a basin, mix it with a little milk as you would for starch; put, in a saucepan, on the fire, half a pint of new milk, sweeten it a little. When it is quite boiling pour it on the arrowroot in the basin, stirring the whole time till it thickens a little; now put it back into the saucepan, and add wine or essence of beef, as may be directed by the medical man, or simply let it boil without other addition.—Or another method is, to take 1 dessert-spoonful of arrowroot, put it into a cup with a tablespoonful of cold water; have on the fire half a pint of water in a saucepan to boil, with 1 inch stick cinnamon, a little grated nutmeg and sugar, to the patient's taste (sick people, as a rule, do not like very sweet dishes). When these have boiled a little, stir in the arrowroot, stir quickly for a minute or so after it is in; if too thick add more water; boil for three minutes and serve, when it is rather cold, in cases of diarrhœa.

29. *Arrowroot and Beef-tea.*—Put a teacupful of strong beef-tea over the fire, in a clean saucepan, to boil; add a little salt, take 1 teaspoonful of arrowroot, moisten it with a little cold beef-tea, and when the beef-tea in the saucepan boils, stir in the arrowroot. As soon as it has boiled three or four minutes, to cook the arrowroot, it may be served with thin strips of dry toast.

30. **Artichoke.**—The Jerusalem Artichoke, *Helianthus tuberosus*, is an edible root, a native of Southern Europe, like the *Cynara Scolymus*, the fleshy bases of the scales and blanched leaf of which are eaten.

31. *Artichokes (Jerusalem) Boiled.*—Wash, scrub, and scrape about 6 medium-sized artichokes, put them into a saucepan with plenty of boiling water, boil till they are tender, try them with a skewer to test when they are sufficiently cooked. Pass them through a wire sieve, season with pepper and salt, add a little piece of good dripping; serve in a hot vegetable dish.

32. Another Method.—Clean and boil, as above, wipe each artichoke, as it comes out of the pot, in a clean cloth

before laying them in the vegetable dish. Make a little melted butter as follows, and pour over the vegetables: $\frac{1}{2}$ oz. of butter, melted in a clean pan; take the saucepan off the fire, stir in 1 tablespoonful of flour, add 1 teacupful (quarter pint) of cold milk by degrees, working the flour into a thin batter, then add the rest of the milk, put a little salt in and place over the fire to thicken, stirring all the time. When it has thickened let it boil for a moment or two to cook the flour, and then serve.

33. *Artichokes (Jerusalem) Baked.*—Clean and pare evenly, and place in a dripping-tin, with some good dripping, and bake in a hot oven. Turn them now and then during the process of cooking, and serve with roast mutton.

34. *Artichokes (Jerusalem) Fried.*—Clean, pare, and slice the artichokes, put them into a saucepan with cold water and salt; let them just come to the boil and strain on the wire sieve, let them drain there, and put into the frying-pan 2 or 3 oz. of dripping. Dip the slices of artichoke in flour and place in the lard when it is boiling. Fry a gold brown, sprinkle salt and pepper over, and serve hot.

35. *Artichoke Soup.*—Clean and pare four artichokes and one onion, boil them in salt and water; when tender, pass through a wire sieve into a basin. Add one pint of skim or new milk, season with salt and pepper, and one teaspoonful of Yorkshire Relish. Stir till the mixture is smooth, put it back into the saucepan, and warm; serve with toast cut into little squares.

36. Asparagus (*Asparagus officinalis* of the order *Litiaceæ*). —A plant indigenous to this country, found in a wild state by the seaside. It is cultivated, and the tender green portions of the young shoots eaten. It contains a principle called *Asparagine*, an alkaloid forming crystals. It is useful in cases of dropsy.

37. *Asparagus Boiled.*—Take the stalks carefully, wash and wipe with a cloth; tie the asparagus in a little bundle, six or eight stalks in a bunch, put them into a stewpan (or saucepan large enough to let them lie flat, and be easily dished without

breaking) with boiling water, salt, and a tiny piece of soda, when they are tender lift them up carefully, preserving the heads or buds from breaking. Have ready some nicely buttered toast, lay the asparagus on this, and pour melted butter over, or, if for an invalid, a little good stock gravy thickened with flour previously browned in the oven, and delicately seasoned.

38. **Australian Meat.**—This meat may be used with great benefit to many households—especially for people who reside in the country, and who cannot readily get supplies of fresh meat. As it is already cooked it requires careful manipulation, if it is to be served up hot. The following receipts may be found useful to those who require to use it:

39. *Australian Meat Pie.*—Cut the meat into neat delicate slices, dip in a seasoning of flour, pepper, and salt mixed, chop an onion and a few herbs, strew some of these in the bottom of the pie-dish, put a layer of meat and then a few herbs, and so on, till the pie-dish is full, not forgetting to use some of the jelly as well as the meat. Make a paste and cover the top, brush over with a little milk; bake in a quick oven, and when the pastry is nicely browned the pie is ready for table, as it is only the paste that has to cook.

40. *Australian Meat Toad-in-the-hole.*—Choose some pieces of lean Australian meat, cut it into neat pieces and place in the bottom of a greased baking-tin, strew a seasoning of chopped herbs, one teaspoonful of Yorkshire Relish, and pepper and salt over; make a light batter by putting in a basin two tablespoonsful of flour, drop an egg in, add a pinch of salt, and mix to a thin batter, with skim or new milk, pour the batter over the meat, and bake ten or fifteen minutes.

41. *Australian Mutton Balls.*—Chop ½ lb. of Australian mutton very finely, also one small onion, soak any stale crusts in cold water for one hour, express the water from the bread, and mix it with the onion and meat, add a few dried or minced herbs, such as parsley and thyme, season with pepper and salt,

mix two tablespoonsful of flour with this and form into balls; dip in egg, and fry in boiling fat.

42. *Australian Meat Soup.*—This soup makes a famous dinner for a working man's family. Take 1 lb. of meat from a tin and chop it a little, peel two onions and slice them, one carrot and one turnip, and 1 lb. of potatoes, all washed, scraped, or peeled, and cut into the thinnest possible slices. Put all this into a large pot with two quarts of water, let it boil slowly for two hours, season with pepper, salt, a teaspoonful of sauce, and serve with bread. Crusts, cut up and put in five minutes before serving, give the soup a rich taste, and use up pieces which might be wasted.

43. *Australian Mince.*—This is one of the nicest methods of using this kind of meat. Boil a couple of onions in a little stock or water until they are tender, mince them, and reduce the stock they were boiled in to about one teacupful; mince 1 lb. of Australian meat, chop some herb, and mix with the onion, meat, and liquor, in a saucepan, add salt, and one teaspoonful of Yorkshire relish; let it become hot, and whilst it is heating make either a wall of potatoes, rice, or, better still, boiled haricot beans on a large meat-dish (see Haricot Beans), put the meat in the centre, and serve hot.

44. **American Beef.**—The pressed beef is very excellent, and is usually eaten just as it is sent over. It is an excellent relish to potatoes and other vegetables, and is nice if cut in thick slices and just warmed in a little good stock with a teaspoonful of some sauce. The American roast beef, too, at 1s. for two pounds is excellent, and only requires heating *in* the tin after it is opened to make a really good dish. Numerous excellent receipts are given on the tins, which answer very well if carefully worked out.

45. **Artificial Asses' Milk.**—Where asses' milk is ordered by the doctor for a patient, and not obtainable, a good substitute may be made by taking one pint of milk obtained from an Alderney cow, if possible, put it into a basin, with $\frac{1}{2}$ oz. of

gelatine, let it soak in the milk for two hours, then put it over the fire, and warm it to dissolve the gelatine; add half a pint of barley-water, 1 oz. loaf sugar, and 1 dessert-spoonful of lime-water. Stir and give to the patient lukewarm.

46. **Artificial Goats' Milk.**—Boil slowly for half an hour, in a pint of new milk, 1 oz. of mutton suet, chopped and tied in a piece of muslin; sweeten with three lumps of loaf-sugar. Let it cool, skim the fat off, and give to the patient lukewarm.

47. **Bacon.**—Home-cured, and forest-fed, makes the best bacon. *If you have to choose bacon*, select that which has a thin rind, the fat firm, white, and tinged a little red toward the rind, by curing, and the flesh of a nice red colour.

48. *Bacon Cake* (Yorkshire).—Make some common paste, line a plate with it, cut the bacon into little pieces an inch square, lay them evenly over the paste, dust a little pepper over, cover with paste, pinch the edges, brush over with egg, and bake in a quick oven.

49. *Bacon, Boiled.*—Bacon, to be well and nicely boiled, should be put into cold water, and allowed to come slowly to the boil, so that the salt may be extracted. Let it boil very slowly, allowing a quarter of an hour for every pound of meat, and half an hour over; skim it well. The fat or grease rising to the top will be nice to clarify. When it is sufficiently cooked, lift it out, take a towel in your hand and pull the skin off, rasp some crumbs from the top of a well-browned loaf, with a bread or nutmeg-grater. It is a spoiling of good bacon and cabbage to boil both together. Boil each separately, and you will be able to save the fat for the children's bread, or the fat-pot, and the greens will be a proper colour.

50. *Bacon Roley-Poley.*—Make a nice suet crust of 1 lb. of flour, put into a basin, mince very finely 4 ozs. of mutton suet, add 1 teaspoonful of baking-powder, a pinch of salt, and mix with sufficient water to make it into a paste. Roll it out to a proper thickness, cut thin slices of bacon, and line the paste with it; season with pepper and 1 onion, and roll it up, flour a

damp cloth, put the pudding into boiling water, and boil for one and a half or two hours.

51. **Baked Ling.**—Get two or three pounds of the middle cut of ling. Grate 2 oz. of bread crumbs, pass them through a wire sieve, put them into a basin with 2 oz. of chopped suet, a teaspoonful of minced parsley, a little salt and pepper, and a little piece of lemon-rind finely shred, mix all well together, moisten with a little milk, and stuff the fish. Put it into a greased baking-tin, with a little piece of dripping, and about 6 or 8 (according to the requirements of the family) parboiled potatoes. Place the tin in the oven, and bake three quarters of an hour, or less if the oven is very hot.

52. **Baked Soup (Yorkshire).**—In Yorkshire everything that can be possibly cooked in the oven is baked; jam, soups, porridge, &c., are, in many Yorkshire villages, made in this useful portion of the range. For this purpose every house is supplied with an earthenware jar, of brown ware, covered by a lid. It must be understood that I am writing about the artizan and cottage homes. The kitchens of the upper classes are conducted according to modern principles. The *soup* is made by placing in the earthenware jar any bones and pieces of lean meat, covering them with water; say there is 1 lb. of bones and meat, there would be three pints of cold water added, and a teaspoonful of salt; this would be put into the oven to stew for three or four hours, and then taken out, the lid removed, and put aside to prepare for soup the next day. The following day *all the fat is carefully taken off*, a couple of onions are peeled and sliced, 2 carrots and 1 turnip scraped or peeled, also sliced and put into the jar, with the stock and 2 oz. of rice, pepper and salt to taste. The jar is then placed in the oven, a couple of hours previous to the dinner hour. The soup is served with either boiled potatoes or bread; a sprig of parsley or a bit of celery is an improvement.

53. **Barley Water.**—Put 2 oz. of barley into an earthen jar, with a small piece of lemon-rind, and about three pints of

water. Put it into the oven when it is not very hot, and let it simmer there for three or four hours. Strain it, and add sugar and lemon juice to taste. The barley will make a very delicious pudding.

54. *Barley Pudding.*—Take the barley prepared as above, add to it $\frac{1}{4}$ lb. sultana raisins, sugar to taste, and a few drops of lemon juice, add one teacupful of milk, grease a dish, and bake it for half an hour. This pudding is excellent for sick people, leaving out the raisins and adding an egg and essence of lemon to flavour.

55. *Barley Tea.*—Place in a jug 2 oz. of barley, the rind and juice of one lemon, and about four lumps of sugar. Pour over it one pint of boiling water, cover with a paper cap and let it cool, and strain into another jug. The barley may be afterwards put with milk into the oven to swell a little, and then made into a pudding as in No. 54.

56. **Bath Chap, to Boil.**—These may be bought cheaper than almost any portion of the cured, dried, and smoked pig. And where people like pork and do not object to fat, they will be found economical. Soak the chap in water all night previous to boiling. Take it out, scrape, and clean it well, and then put it into a pan with cold water, and allow it to boil gently for a quarter of an hour to the pound weight, and a quarter of an hour over. Take it up and remove the skin. Grate some brown bread-crust over. It is usual to serve boiled parsnips or greens with this dish whilst hot, but do not boil them with the meat as it will retain the flavour after, and it is no improvement to the vegetables. The liquor in which the chap is boiled will make excellent pea-soup or vegetable soup the next day.

57. **Batter for frying fish, meat, or fruit.**—Put into a basin $\frac{1}{4}$ lb. of flour, drop into it the yolk of an egg, put the white into a clean dry basin, add to the flour $\frac{1}{2}$ oz. of butter melted to an oil. Mix to a light batter (but not too thin) with tepid water, let it stand for an hour or so whilst you prepare the

fish, meat, or fruit. Then put a frying-pan on the fire with $\frac{1}{4}$ lb. of dripping, let it get quite hot, test it with a piece of bread, if that browns quickly the fat is ready. Now whip the whites of the eggs to a stiff froth, stir it thoroughly into the batter. Dip the fish or whatever you wish to fry into the batter, plunge into the boiling fat. When it is a rich brown it is sufficiently cooked; drain on a piece of paper, sprinkle over with salt or sugar according as the dish is savoury or sweet. Oil may be used instead of butter if it can be afforded; in fact it is preferable.

58. *Batter Pudding, boiled.*—Put two heaped tablespoonsful of flour into a basin, drop in one egg, add a small pinch of salt; add by degrees half a pint of milk, working it into a smooth batter with a wooden spoon. The more it is worked the lighter the pudding will be. Grease a basin thoroughly, pour the batter in, grease a paper with a little dripping, put it over the top, place the basin in a pan with boiling water which will reach about one inch *below* the rim of the basin. If the water gets low in the pot add hot water from the kettle or boiler, pouring it down the *side of the pot*, NOT OVER the pudding, taking care when more water is added that it will not rise above the rim of the basin when it boils, or the pudding will be watersoaked. Boil slowly for $1\frac{1}{2}$ hours.

59. *Batter Pudding, baked.*—First prepare the oven and make it thoroughly hot; then mix the batter as in No. 57. Grease a tin dish or baking tin, pour the mixture in, place in the oven, and bake twenty minutes. Serve with meat, gravy, sugar, preserve, or treacle, and use while hot.

60. **Beef, to roast.**—Put the meat before the fire by hanging it on the hook. Place it close to the fire at first, as on page 274, basting continually during the process of roasting. Allow half an hour over the quarter given for each pound of meat. Prepare the gravy as in No. 223, remembering to pour it *round* the meat when dishing up. Five minutes before taking the joint from the fire, dredge it lightly over with flour, taking

care not to put a thick coating, but simply a slight dusting. Horse-radish sauce and horse-radish scraped are sent to table with roast beef, and will be found under their respective heads. On page 263, directions are given for choosing beef.

61. *Beef, Silverside of, to bake.*—Prepare the following stuffing: Put into a basin 4 oz. bread crumbs, 2 oz. suet, a little lemon rind (chop the two latter very finely), 1 teaspoonful chopped parsley, 1 teaspoonful each of thyme, marjoram, and chives (or shalot). Mix well with the bread crumbs, &c.; break an egg into the basin, strew over the contents a little pepper, salt, and cayenne; mix all together, take out the bone carefully and put it aside for the stock-pot; fill the place where you have cut it out with stuffing, skewer it over, wind twine or tape round it to keep the meat in a good shape; now put the meat on a stand so that it may not touch the dripping, but remain above it, so that the hot air may reach every portion of the meat and produce the delicious crispness so much appreciated in properly baked meat. Meat sodden in the fat, or even in water which is sometimes introduced into the dripping-tins to make gravy (?), is very unpleasant to eat.

62. *A palatable way of serving up cold Beef.*—Take two large onions, slice into the frying-pan and partially cook them. Mix ¾ pint stock (or water), add to the onions, stirring all the time. When boiling, add salt, pepper, and a tablespoonful of vinegar. Put in slices of cold beef and allow these to *simmer* until warm through. If allowed to *boil*, the beef will become tough.

63. *Beef, minced and baked.*—Chop or mince the beef, season, and place in a pie-dish. Take any cold potatoes, and mash with a little milk and salt. Make a paste with these, cover the meat and bake in the oven until the potato crust is nicely browned.

64. *Beef Roley Poley.*—Take 1 lb. of the lean, fleshy part of beef, commonly called 'sticking part;' cut it into nice, long, even slices; add the scraps to one end. Soak some

crusts in a basin till they are soft, drain them, and mix with them a chopped onion, pepper, salt, and a dessertspoonful of parsley, also a quarter of a pound of suet (minced finely), add two cloves; place this evenly over the meat, and roll it up, beginning at the end where you have patched the meat. Flour a cloth, roll the meat in it, secure at the ends with twine. Plunge it into a pot with boiling water, boil for about ten minutes very rapidly, then draw to one side and let it boil gently for about four hours; take it up, let it get set, remove the cloth, first dipping it in boiling water. This makes an excellent cold meat for a working-man to take out for his dinner, if cut in thin, delicate slices, wrapped in a clean cloth, and eaten with brown bread at the dinner hour.

65. *Beef Tea.*—Take 1 lb. of the sticking part of beef, take off all skin and fat, mince it very finely, and mix with 1 pint of cold water, till each little grain is separated; then put it in an earthen jar, into a *cool oven* for three hours, or into an enamelled saucepan, and place *near* (not *on*) the fire, so that the gradual application of the heat may extract the red juices. *Do not add salt* to *any* beef tea in serious cases without permission of the medical attendant.

66. *Beef Tea* (*Hospital*).—Half-chicken, 1 lb. of beef, 1 lb. mutton, remove all fat, sinew, skin, &c., from the butcher's meat, mince it very finely, also remove the flesh from the chicken and mince it also. Take the bones, crush them, and remove the marrow from leg and wing bones and put it all into an earthenware pot, put a paper cap over and place in a saucepan with sufficient water to come half-way up the pot containing the minced meat. Stew for four hours, keep the water up to this level by adding *boiling* water to that already in the saucepan. When the patient is extremely weak, this mixture will remain on the stomach when all other foods fail. Strain through muslin with a sheet of white blotting paper placed on it.

67. *Beef Tea* (*raw*).—One tablespoonful raw gravy beef

minced fine, one tablespoonful of water added, stir well with silver spoon, let it stand ten minutes, strain, and serve to the patient in a covered medicine cup. This is used in the London Hospitals in cases of typhoid and smallpox.

68. *Beef* (*Essence*).—Half-pound gravy beef freed from fat, minced finely, put into gallipot, covered with paper cap, and bake in a SLOW OVEN two hours. Strain and serve.

69. **Beans, French, to boil.**—Scarlet-runners or French beans may be first wiped or washed to remove all grit; then take a small piece off the top and the stripe of fibre that runs down the sides, cut the French beans in narrow fine strips lengthways and the scarlet-runners in slanting slices very fine, put them into a saucepan of boiling water, with one dessert-spoonful of salt, and a little lump of washing soda as large as a pea; boil them in plenty of water, keeping the lid off the whole time; drain them on the wire sieve, serve with a small piece of butter stirred in amongst them. To test if they are cooked take a piece out with a fork, and if tender it is boiled enough. From ten to twenty minutes is the usual time which beans require to boil, varying with their age; a lump of sugar added to the beans if old or not freshly gathered is an improvement.

70. **Broad Beans.**—Shell the beans either in the usual way, or by placing them in a bucket and pouring over them a kettleful of boiling water. This will greatly economise time, as the beans will soon slip out. Have ready a pot with boiling water, put in the beans, add an iron spoonful of salt, boil from a quarter of an hour to half an hour, according to the age of the beans. Test them as in No. 69; they are served with either chopped parsley strewed, and butter stirred in amongst them, or with melted butter and parsley in a sauce-boat.

71. *Broad Beans, Scotch Fashion.*—The beans after being shelled are blanched, *i.e.*, put into a saucepan, and allowed to boil in salt and water for one or two minutes and slipped out of the husk; they are then put into a saucepan with

sufficient boiling water to cover them, a teaspoonful of salt and a piece of soda; in about ten minutes examine them, and if tender drain on the wire sieve, and when quite dry pulp them into a clean basin through the sieve. Mix with a tiny piece of good dripping, season with pepper and salt, grease a cup well, fill it, and turn the shape out on a vegetable dish, greasing and refilling till the whole of the beans are dished; put into the oven, with a basin inverted over the dish, to warm the beans, and serve with or without melted butter and parsley over. This is much the most pleasant method of sending beans to table for the comfort of the diners. If the blanching process is too troublesome, the beans can be rubbed through the wire sieve after boiling in the shell, a few at a time, throwing away the husks as they become empty, but it is more wasteful, and the beans are never such a pretty colour as when dressed as directed in the first part of this receipt.

72. **Bilberry Pudding.**—Make a suet crust, grease and line basin, half fill it with fresh bilberries, strew 2 tablespoonsful of sugar over them, and continue to fill the basin till it is heaped up. Put the top crust on and flour a cloth, tie it over, and boil for 2 hours. Bilberries in any form, either uncooked, made into pies, puddings, jam, or syrup, are particularly good for people suffering from scrofula, whether of the lungs or however it may be developed.

73. *Bilberry Jam.*—Gather the berries on a fine dry day, and after the sun has had time to dry the dew or moisture off the berries; weigh the fruit, put into a preserving pan with 1 pint of water, let it boil half an hour, and then add 6 pounds of sugar to every 7 pounds of fruit. Boil for three quarters of an hour; test it at the end of that time by putting a little in a saucer; put it out of doors to cool, and if it sets it will be found to be sufficiently cooked. If not boiled enough it will not set firmly. Fill dry jam pots in the usual way, and cover down when cold with brown paper.

74. *Bilberry Syrup.*—Put 2½ lbs. of loaf sugar into a

saucepan with 1 pint of water; let it boil for a quarter of an hour, stirring all the time. Put on the fire, in a saucepan, 3 lbs. of bilberries; let them boil for half an hour, pass them through a jelly bag, and add the juice to the syrup. Clear with the white and shell of one egg, lightly whipped, and put into the syrup. Put it on the fire again, let it boil well up for three minutes; lift it carefully to one side, skim all the froth off as gently as possible, then pour into bottles and cork for future use. 1 tablespoonful in a tumbler of water before breakfast is considered quite a heal-all by some of the people in the midland counties. It certainly contains some valuable acids, and is a refreshing beverage on a hot summer's day.

75. **Beetroot** (*Beta Vulgaris*).—Is rich in carbonaceous food. There are several varieties. The white sugar beet is grown largely on the Continent, and used in the manufacture of sugar; it is computed that over two million tons of this sugar are made annually. It may be known from cane sugar by the peculiar whiteness of the moist sugar, and the softness of the crystals. It also produces, from the refuse of the sugar, molasses, which yield from 25 to 30 per cent. of pure spirit, at about 1s. per gallon, used largely for the making of mock whiskies and brandies. From the further refuse left from distillation excellent potash is obtained, and from the refuse after the manufacture of potash, pasteboard and brown paper; thus one beetroot contains substances from which sugar, spirit, potash, paper, and pasteboard can be successively obtained, without waste of material.

The Mangold Wurzel is another name under which we discover the beet, and is cultivated principally for the use of cattle in this country. The red *Garden Beet* is the one with which we shall have to deal. It is richer and more juicy, and of a brilliant red colour; the fibrine, too, is finer. Beetroot bears the proportions of 35 parts carbonaceous to 1 part of nitrogenous matter.

76. *Beetroot Salad.*—Carefully raise a beetroot from the

ground with a prong, being sure that it is not broken or the skin disturbed; put it, leaves and all, into cold water, and let it lie for a couple of hours to loosen the earth, wash it off, but do not break the skin. Cut the leaves, leaving about two inches of them from the crown of the root. Put into a moderate oven, and bake for an hour-and a-half or two hours; take the root out, and let it become perfectly cold. Peel the skin off and slice in rings; add rings of hard boiled eggs, and one Spanish onion, boiled or raw, as preferred. Season some vinegar with one teaspoonful of sugar, a little pepper, salt, and a teaspoonful of ready-made mustard, and pour over the salad. This is excellent with cold meat.

77. *Beetroot Jam and Colouring.*—Bake the roots as in No. 76; when they are cold, weigh and peel them. For every pound of beetroot, take the rind and juice of one lemon; peel the rinds very thin, and strain the juice; also use six pounds of sugar for every seven of beet. Put the sugar into a saucepan with two pints of water, the rind and juice of the lemons (or oranges if they are preferred), stir till all the sugar is dissolved, let it boil whilst you cut the beetroot into slices, and put them into the syrup, let it boil for a half an hour and pour into pots, cover it up when it is cold. One teaspoonful of the syrup from this jam will colour any sweets most beautifully—a blancmange, for instance—and be much more wholesome than bought colouring.

78. **Braising and Larding a Capon.**—Most dishes that are braised are previously larded. Choose a good capon. Draw it in the ordinary manner, but before trussing, cut some slices of bacon into thin slices, and again into strips, which are a very little smaller in size than the end of the larding-needle. Then begin at the neck of the capon, and lard in regular, neat, alternate rows down the breast, *i.e.*, beginning the second row between the stitches of larding, and the third row on a level with the first; the fourth on a level with the second, and so on. When larded stuff with sausage meat or lemon stuffing, truss,

and put it into a braising-pan *on* the following vegetables: one small turnip peeled and cut into slices, one carrot scraped and sliced, half a leek (the white portion), a bunch of sweet herbs, six cloves, six whole peppers, and a blade of mace. Lay the capon on these, butter a piece of kitchen-paper cut round the size of the pan, and lay over the capon. Put sufficient stock in the pan to reach to the paper; put it over the fire and let it stew slowly for about one hour, then place hot coals on the top lid of the braising-pan, first removing the paper, until the surface is completely browned. Remove the capon on to a clean dish, reduce the gravy, melt some gelatine and mix with the gravy; boil to a glaze, and pour over the whole capon, so that every portion is covered with the glaze.

79. **Bread, Home-made.**—Take 7 lbs. of flour and put it into a clean dry earthenware pan; mix one tablespoonful of salt well into the flour, put 2 oz. of fresh German yeast into a basin, mix into a smooth batter with half a teacupful of tepid water; make a well in the centre of the flour, pour this barm in, mix it up at once with tepid water into a nice stiff dough, kneading it well *(the more it is kneaded the lighter and better it will be)*; leave it until it has well risen, then see that the oven is nice and hot; *without working too much*, fashion into loaves, flour the tins and place in each dough enough to half fill them, leave it a quarter of an hour in a warm place to rise, and then put into the oven and bake. Test with a bright skewer; if the skewer comes out bright and clean, the loaf is done; if not, it must have more baking. There are many very good receipts for making bread, and every good housewife has her own way; for students the above method will be found to answer in every respect for practice.

80. *Bread-pudding* (*cheap*).—Soak about one pound of crusts or pieces of bread in one quart of skim milk for three or four hours; chop $\frac{1}{4}$ lb. mutton suet very finely, and when the bread is well soaked, beat it up with two tablespoonsful of sugar, the suet, $\frac{1}{4}$ lb. of currants, and $\frac{1}{2}$ packet of mixed spice;

grease a tin pie-dish, put the pudding in, lay one or two pieces of dripping here and there, put it into a moderate oven, and bake an hour. If the currants are left out, the pudding is very nice eaten with cheap home-made jam.

81. *Bread Pudding* (*savoury*).—Soak the crusts in skim milk as in No. 80, mince ½ lb. of suet, one tablespoonful of parsley and thyme, mixed; beat these up with a fork in the bread, also season with pepper and salt; bake in a tin dish and serve with hot gravy.

82. **Broth, Kettle.**—Cut up some crusts or a slice of bread into a basin, add a piece of dripping as large as a walnut, pour boiling water from the kettle upon the bread, and season with pepper and salt.

83. **Bone Broth.**—Get 2d. or 3d. worth of bones, pound them with a hammer so that they are broken into small pieces; put them into a pot with two or three quarts of water, and let it boil five or six, or even eight hours, till reduced to about two quarts; skim and clear from all fat and grease whilst it is boiling; strain the liquor. When it is cold be sure to remove every particle of grease; add to the liquor, when you wish to use it for broth, one carrot scraped, washed and cut into rings, one turnip washed, peeled and cut into slices, one onion, peeled and sliced, ½ lb. of either Scotch barley or rice, a little chopped parsley, thyme, and savory should be added, together with pepper and salt, half an hour before serving; but the broth must boil until the vegetables and barley are cooked—about one hour altogether. This will make a good, substantial dinner with bread.

84. **Breast of Mutton.**—(See Receipt No. 288.)

85. **Brocoli, to boil.**—Cut a brocoli, put it into salt and water sufficient to cover it, with the flower downwards, and let it remain for about an hour; rinse in cold water under the tap; if it has been raining, *put a little vinegar into the water*, and it will bring out any slugs that may have taken refuge amongst the branches of the flower. Have ready a pot with boiling

water in it, one tablespoonful of salt, and a little soda. After trimming the brocoli, put it in, *flower downwards*, so that any scum which may arise will rest on the stalk, and not on the flower. Try it with a skewer at the end of a quarter of an hour, and if done, lift carefully out with a slice on to the wire sieve to drain; then place in the vegetable dish, and serve melted butter in a sauce-boat, or good thick gravy.

86. **Bullock's Heart, stuffed.**—Put the heart into salt and water to soak for an hour; clean it thoroughly, and trim, cutting off the deaf ears. Make a stuffing of minced suet, parsley, and thyme, with a tiny bit of lemon-peel (if you have it), mix all well together, moisten with a little milk, stuff the heart, and skewer a piece of buttered paper over. Put it into a stew-pan with a carrot, turnip, and onion, all properly prepared. Stew it for an hour, turning it round, but not piercing it with a fork. Lift it out and place on a baking-dish, and bake in the oven for half an hour or more, according to the size, or roast in front of a bright fire; in either case, baste well. Serve on a very hot dish; reduce the liquor the heart was stewed in sufficiently to make gravy, and pour round the meat.

87. *Bullock's Liver.*—This is best larded (and as larding needles are not expensive it will not be out of place in Artizan Cookery), and makes a nice relief to liver and bacon, which every cottager in the country knows. Cut the bacon and lard as directed in Recipe 78; when the meat is neatly larded make a stuffing, as above directed, for the heart, No. 86, and spread over the bottom of a greased tin. Lay the liver on this, put into a quick oven, and bake for three quarters of an hour. Make a thick gravy from the stock-pot liquor, thickened with flour, and coloured with caramel (No. 106).

88. **Bubble and Squeak.**—Take any cold cabbage and cold potatoes, rub both together through a wire sieve, or chop it very finely, mix well and season with pepper and salt. Put into a greased basin, with a bit of dripping on the top, place a

pot on the top, and put it into the oven to warm. Fry some slices of cold meat in boiling lard or dripping, sprinkle with pepper and salt. Be careful not to fry the meat too hard, only just to warm it in the boiling fat, and lightly brown ; when the meat is cooked turn the vegetable out of the basin on to a meat dish, and arrange the meat round.

89. **Bread Sauce.**—Make about half a pint of skim milk hot over the fire, with an onion in the pan as well. Pass through the wire sieve about $1\frac{1}{2}$ or 2 oz. of bread crumbs. Remove the onion after it has been in the milk 5 or 10 minutes. Put the milk over the fire again, and, when it begins to boil, take the crumbs in the left hand, and a wooden spoon in the right hand, stir the milk whilst you strew in the crumbs, and stir also whilst it boils for 3 or 4 minutes; season with pepper and salt, and add a bit of butter as large as a walnut. If it is too thick add more milk, and always remember it is a SAUCE, not a *poultice*, which is being made.

90. **Blackberry and Plum Jam.**—Open the plums and crack the stones. Let there be 1 lb. of plums to 3 of blackberries ; see that the blackberries have been gathered during dry weather. Put all into a large saucepan and boil for one hour, skim well and carefully. Then add six pounds of sugar to every seven pounds of fruit; boil it for half or three quarters of an hour, fill the jars, and when it is cold, tie down. Blackberry and apple jam, or plain blackberry, may be made as above, leaving out the plums and substituting peeled, cored, and sliced apples, or by boiling the berries by themselves.

91. **Cabbage.** *Brassica Oleracea*—contains many valuable properties in scorbutic cases; like the potato it contains a large percentage of potash. It was first introduced into this country from Holland.

92. *Cabbage Soup.*—Take 2 quarts of the liquor in which meat has been boiled; free it from fat. Cut up 1 or 2 heads of cabbage after they have been thoroughly soaked in salt and

water, examined, and washed. Put it into the stock-liquor in the pot; wash and peel ½ lb. of potatoes, peel ½ lb. of onions, slice these very finely, and put into the pot; also, ½ lb. of liver, minced very finely, season with pepper and salt, and let it boil for two or three hours, stirring frequently from the bottom of the pan. Pass all through the wire sieve, mix thoroughly the liquor with the pulp, return to the saucepan, and keep warm; serve with either toast or crusts of bread, broken up into a basin, and the soup poured over. If there is no pot-liquor to use cut up ½ lb. of green bacon, in dice, and boil with the soup.

93. *Cabbage and Mince* (Cologne recipe).—Choose a large, firm cow cabbage or savoy. Clean and boil it in the usual manner with the lid off, with soda and salt added to heighten the colour and make it savoury. Many Germans add a lump of sugar. When it is well cooked, lift it on to the wire sieve and press all the water out, then place it on a hot dish, and cover with the following mince, which should have been prepared whilst the cabbage was boiling. Chop any cold meat very finely, season with pepper, salt, onions, and herbs, chopped finely. Pass through the wire sieve 2 oz. (or more) bread crumbs, so as to make the quantity, when mixed with the minced meat, sufficient to cover the cabbage. Cover the cabbage over with this mixture, and bake it in the oven till it is quite brown on the top. Serve at once with gravy in sauce tureen.

94. *Cabbage, Stuffed.*—Take a firm-hearted cabbage and cut out the stalk portion. Mince about four tablespoonsful of cold meat, also one onion, season this with pepper and salt, add one teaspoonful chopped parsley, stuff the cabbage, tie it in a flour-cloth, and boil for half or three-quarters of an hour, according to the size. Prepare a thick gravy. Take some stock from the stock-pot, put it into a clean saucepan, and put it over the fire to boil. Mix in a basin one tablespoonful of baked brown flour, season with pepper and salt, and mix with a little cold milk; when the stock boils, stir in the flour

mixture, continue stirring till it thickens and boils, then pour into a hot sauce tureen and serve with the cabbage.

95. *Cabbage, to Pickle.*—Choose full, firm heads. If white cabbage is used, the cow cabbage is best. Slice in fine delicate slices, place it on a dish or in an earthenware pan, cover it with salt, and let it remain on for twelve hours. Drain on a hair sieve or on a coarse towel, stretched and tied over the legs of an inverted chair, with a basin placed under to receive the salt water. When it is quite dry, loosely fill the bottles or jars. Put on the fire to boil $2\frac{1}{2}$ quarts of vinegar with 2 oz. cloves, one tablespoonful of moist sugar, $\frac{1}{4}$ lb. of peppercorns, $\frac{1}{4}$ lb. bruised ginger, boil for half an hour, put it out into a basin or dish, and when quite cold pour over the cabbage. It will be ready for table in a week, and when thus treated the red cabbage retains its beautiful colour, whilst all the essence of the various spices are extracted by the vinegar in the process of boiling. ANOTHER METHOD is to slice the cabbage as before, and then put into a deep pan. Bake a beetroot; when cold, peel, slice, and add to the cabbage (some people prefer the beetroot raw). Put into a saucepan sufficient vinegar to cover the cabbage, add to it in the proportion of—1 oz. cloves, 1 oz. mace, peppercorns 2 oz. to the quart of vinegar, also one tablespoonful of salt. Boil for ten minutes, and pour whilst at boiling heat over the cabbage. Next day drain off the vinegar, boil for half an hour and again pour over the cabbage; repeat this operation on the third day. When it is quite cold, bottle, and it is ready for immediate use.

96. *Cabbage Balls.*—Mince some cold cabbage finely, mix it with equal part bread crumbs, season with pepper and salt, bind with an egg. Form in large-sized balls, roll in flour, and fry in boiling fat. Drain on paper, sprinkle over with salt, pile in a pyramid, and serve hot with gravy.

97. *Cabbage, plain boiled, with Egg Sauce.*—Boil an egg hard, *i.e.*, for half an hour, and place it in cold water at once on lifting it from the saucepan. Put some cabbage into a pan of

clean water with a little salt and vinegar, let it lie an hour and then thoroughly examine it, cut each head in four, and rinse in clean water. Now place the cabbage in a saucepan over the fire with boiling water, a tablespoonful of salt, and a piece of soda as large as a hazel nut. Let it boil until the cabbage is tender, drain on a wire sieve, and press the water *thoroughly out.* Make the sauce and have it ready to pour over. Shell the egg carefully, remove the yolk, chop the white *very finely*, and stir it into some seasoned melted butter. Pour the sauce over the cabbage. Dry the sieve and press the yolk of the egg through it over the cabbage and sauce, and you will have not only a tasty, but an elegant-looking dish.

98. *Cabbage and Bacon baked.*—Take any cold cabbage, chop it, and season with pepper only. Take some rashers of bacon, cover the bottom of a pie-dish with some of the slices of bacon. Add a layer of cabbage, and then bacon, until the pie-dish is full, putting a layer of bacon on the top. Mash, through a wire sieve, any cold potatoes with a bit of dripping, mix in also pepper and salt; put this as a crust over the cabbage and bacon. Place in a quick oven, and bake for three-quarters of an hour. Slices of cold boiled bacon are nice re-warmed in this manner.

99. **Capers** (*Capparis Spinosa*)—of the Capparidaceœ order of plants, chiefly grown in the southern parts of Europe. The unripe fruit, or flower-buds, are chiefly used; they are prepared for the market by being pickled in white wine vinegar, and are often subject to poisonous colouring in the process. A few brands may be depended on, but *very green* capers are always objects of suspicion.

100. *Capers* (*Mock*).—A preparation at once wholesome, cheap, and within the reach of the pocket of the working man's family, may be made by sowing in the spring, about the first week in May, 3 or 4 pennyworth of Major Nasturtiums (Tropœolum Majus), and gathering the YOUNG seeds or fruit as they appear. Choose a nice, fine day to pick the seeds,

place them on a dish, strew salt over them for 24 hours, drain, and place in bottles. Boil for twenty minutes sufficient vinegar to cover them, with 2 oz. of *white* peppers to the pint of white vinegar, let it cool after boiling, and then pour over the capers, straining off the white peppers, which will do for other pickle after, or may be used for a second boiling of vinegar for mock capers. Green peas are sometimes pickled as above, and used for caper sauce.

101. *Caper Sauce.*—Take a tablespoonful of mock capers, chop them finely; prepare some melted butter, stir into it one tablespoonful of vinegar, add the mock capers, and serve in a tureen. This sauce is used with boiled mutton; it is nice with rabbit and fish.

102. *Cake, Plain Seed.*—Take 2 lbs. of flour, put it into a basin, rub into it 4 oz. of good dripping, mix $\frac{1}{4}$ lb. moist sugar, a heaped teaspoonful of baking powder, and 1 oz. of carraway seed thoroughly with the flour and dripping. Take as much tepid water as will form it into a light dough. Mix well, but not too much, flour a baking-tin or tin pie-dish, and place in a hot oven and bake for about two hours, test with a skewer as in bread; No. 79. When it is nearly done, brush over with a *little* milk or water, just to develop the *dextrin* and give the cake a glaze. Currant cake can be made in the same way, using $\frac{1}{4}$ lb. currants instead of the seeds. This is nice for children's tea and supper, and will save butter in the winter season.

103. *Cake for Family Use, à la Gothard.*—$\frac{1}{2}$ lb. ground rice, $\frac{1}{2}$ lb. Johnstone's cornflour, 1 lb. households flour; mix well together. Rub $\frac{1}{2}$ lb. of dripping into the flour, &c., add $\frac{1}{4}$ lb. moist sugar, one teaspoonful baking powder, half teaspoonful carbonate of soda, and 1 lb. sultana raisins carefully picked; mix all these dry ingredients well together, then drop in one egg, and sufficient water to make the dough, mix well and lightly, drop into a well-greased tin, but do not fill it. Let the dough fill about three-quarters of the tin, so that it may

rise. Tie a band of greased paper, rising a couple of inches above the rim of the tin, place in a quick oven, bake for one and a-half or two hours, and test with a bright skewer. This is better two or three days after it is made. In fact, it improves by keeping.

104. *Cake from Dough.*—Take 2 lbs. of dough (see No. 79), put it into a large basin or pan, and place near the fire to keep it warm until you are ready to make the cake. Get ½ lb. of good dripping, ½ lb. currants nicely washed, cleaned, and put down to the fire to plump, also 3 oz. of moist sugar. Put on the table a paste board, roll the dough out with a rolling-pin till it is quite thin, *spread* a third of the dripping, currants and sugar over the surface, fold in three, roll out again, repeat this operation twice more, work up lightly, fashion into rounds and place in well greased baking-tins. Bake from one and a-half to two hours, according to the quality of your fire and oven, and test as before.

105. **Carraway Seeds** (*Carum Carvi*).—A plant largely cultivated on the Continent, and in the South-Eastern Counties of England, for its seeds. It is very prolific. It is used as a sort of spice or flavourer.

106. **Caramel, or Colouring for Soups, Gravies, &c.**—Put the sugar into an iron saucepan, stir it until it becomes *perfectly black*, add one quart of water, let it boil five minutes, strain and bottle. A good colouring is made from chicory; quarter of a pound put into a jug, and one pint of boiling water poured upon it. Strain when cold, and bottle. It is tasteless.

107. **Cow's-heel Stock.**—Get a dressed cow's heel from the butcher, *i.e.*, a cow's heel with the hair scraped off (not cooked in any way), wash it, put it into a saucepan with sufficient cold water to cover it, and one tablespoonful of salt, let it come slowly to the boil, skimming carefully; when it has just boiled lift out the foot, scrape it and wash in cold water, and put on again in cold water (3 quarts); let this boil slowly for six

or eight hours, stirring now and then, so that it may not adhere to the bottom of the pot and burn; skim all oil and fat off with an iron spoon into a clean jar (the oil is useful for domestic purposes). Strain the liquor off the heel at the end of eight hours. (N.B. The heel will make excellent *soup* next day and the remains made up into collared meat, cow-heel pie, or savoury stew; Nos. 109, 110, 111.)

108. *Cow's-heel Jelly.*—Take one quart of the stock, put it into a clean stew-pan, with 2 oz. lump sugar, the thin rind of the lemon and oranges, one inch of cinnamon, a lump of nutmeg as large as a cherry stone, twelve coriander seeds, six cloves. Place the stewpan over the fire, so that the stock may dissolve whilst you wash and dry two eggs, and separate the yokes and whites of two eggs, keeping them in separate basins. Now crush the shells and put them into the basin containing the whites, beat them with a whisk a little, and add at once to the stock over the fire; take your whisk, and after whisking for a minute, stir evenly *one way* till the stock boils. Let it boil for two minutes, and lift carefully to one side to let it settle a little; have ready the strainer as in No. 1 of this series. Dip your moulds into cold water, turn them upside down for a moment, and then pour in the jelly that has been strained through the muslin. If the weather is hot, set in ice to cool.

109. *Cow's-heel Collard.*—Take a cow's heel after it has made either jelly or soup, cut the meat into dice and put bones and meat into a saucepan with three pints of water, season with pepper and salt, a little powdered nutmeg or mace (if liked), a bunch of sweet herbs, and let the whole stew slowly for three hours, stirring now and again in case it should burn. At the end of that time remove the bones. Have a hard-boiled egg ready, shelled and cut into rings, place them as a sort of decoration in the basin, and after removing the bunch of sweet herbs, pour the whole into the mould or basin. Let it set and then turn out on a clean plate, first dipping the mould into warm water for an instant.

110. *Cow's-heel Pie.*—Slice the cow's heel. Put on a plate one tablespoonful of flour, one teaspoonful of salt, half a teaspoonful pepper, quarter teaspoonful nutmeg, mix well. Put the bones on to stew with an onion, some herbs and seasoning, let them stew whilst you finish the pie. Dip each slice of meat in the flour mixture, place it in even layers in the pie-dish, sprinkle dried herbs over and a little chopped onion. Pile the pieces up high in the centre. Now strain the gravy into the pie-dish. Make a cover for the pie of ordinary paste. Bake in a quick oven for an hour.

111. *Cow's-heel Stew.*—Cut the meat into neat slices, pare a small turnip and slice it, scrape, wash, and slice a carrot, peel an onion and slice it, put the vegetables in first, and the cow's heel on the top, add sufficient water to keep the meat and bones well covered and stew for three hours, stirring now and again, adding more water if necessary. Quarter of an hour before serving add to the stew one tablespoonful of chopped parsley, also one teaspoonful of lemon thyme. Lay the meat on a hot dish when it is ready to serve. Pass the gravy through, and also the vegetables; pour this over the meat, and garnish with fried crutons of bread or toast cut into triangles and place round, not sopped in the stew.

112. *Cow's Heel Baked.*—Cut the meat off the cow's heel after it has been used for (108 or 109) soup or jelly; slice it. Peel and slice one onion, put a few slices in the bottom of a pie-dish, also a few bread crumbs. Lay the meat in season with pepper and salt, one or two cloves, the onion and bread crumbs being strewn over each layer. Put one or two pieces of butter or dripping over the top, add a teacupful of stock or water, and put into a moderate oven for half an hour.

113. *Cow's Heel Fried in Batter.*—Prepare the batter as in No. 50, seasoning it with half teaspoonful of salt, and quarter teaspoonful of pepper. Boil the cow's heel until it is *quite tender*, and whilst warm lift on to a dish. Cut in slices, dip into the batter, and fry in boiling fat until it is a bright golden

brown, sprinkle over with salt when you dish it up. Fry some parsley and garnish ; send to table as hot as possible.

114. **Carrots** *(Daucus Carota)*.—The carrot is indigenous to this country, in a wild state it is anything but the mild, agreeable food we find it when under cultivation. It is nutritious, but unless well mashed is not easy of digestion. It is rich in saccharine matter as well as in flesh formers. Long red carrots are best.

115. *Carrots, Plain Boiled.*—Wash and scrub 3 carrots. Put them into boiling water with salt and a piece of soda as large as a nut to heighten the colour. Boil with the lid off. Try whether the carrots are sufficiently cooked with a skewer, and, when done, take them up separately, rub the skin off, cut them even, and put into a saucepan with chopped parsley, and a bit of butter or dripping as large as a hazel nut. Toss them for a few minutes until warm and quite covered with the parsley and butter. Dish on a warm vegetable-dish.

116. *Carrots Mashed.*—Boil the carrots as in No. 115 ; rub the skins off and pass through a wire sieve ; mix a tiny bit of dripping with them, season with pepper and salt. Grease a cup and make little shapes of the carrot ; place in a warm vegetable dish, and put into the oven a few minutes to warm. Serve hot.

117. *Carrot-balls.*—Boil 3 carrots as in No. 115, mash them, and pass through a wire sieve, season with pepper and salt, add a little piece of dripping as large as a walnut ; pass through a wire sieve about 2 oz. of bread crumbs, mix 1 oz. with the carrots, reserving the other ounce ; mince very finely 2 oz. of Australian or any cold meat ; mix all well together ; break an egg into a basin, blend it a little, put one half to the carrot mixture ; flour a board, and form into little balls, dip them into the egg, Have the spare bread crumbs in a piece of clean wrapping paper, toss the little balls in them, and fry a nice bright brown in boiling fat.

118. *Carrot-pudding.*—Scrape, wash and boil about ½ lb.

carrots as in No. 115, pass them through a wire sieve into a basin, add 1 tablespoonful of sugar, 3 drops of essence of lemon. Make a custard of 1 egg and a teacupful of milk; after blending the two well together with the whisk, add to the carrots. Grease a pie-dish, pour in the mixture; place tiny pieces of dripping here and there over the top; bake in a moderate oven for three-quarters of an hour.

119. *Carrot Marmalade.*—Scrape, wash and slice into thin rings three pounds of bright red carrots; boil until they are quite tender; mash them. Put into a large saucepan $1\frac{1}{2}$ pints of water for every lb. of carrots. Slice on a plate, so as to save the juice, three oranges which have lain in strong brine for 12 hours: remove the pips, and add to the water in the saucepan; add the carrot, and boil for two hours, stirring every now and then to prevent its sticking to the pan. When the orange rind is tender, at the end of the two hours, add 1 lb. of sugar for every pint basinful of liquid in the pot. It must then boil for 1 hour, stirring the whole time with a wooden spoon. Put into jars, when cold, tie down with brown paper. Halfpenny oranges are best for this purpose, as the rinds, as a rule, are fine, and the flesh juicy.

120. **Celery.** — *Apium gravelous.* — Indigenous to this country and most parts of the continent. Its natural habitation is near the sea-coast in sandy soil. Celery is usually sent to table in a raw state, and eaten as a relish, or dressed as a salad. It contains mannite, mucilage, starch, saccharine matter, and also an essential oil, which renders the plant useful when given in cases of dropsy. The seeds possess this oil in a greater degree than the other parts of the plant. Confections are made from the plant and the seeds on the Continent, and in this country both are used for savoury stews, soups, &c., as flavourers.

121. *Celery stewed.*—Take a head of celery, steep it in salt and water for one hour; then thoroughly clean, trim the roots, take off and put on one side the outer stalks and leaves; cut

the head in two (lengthwise), rinse in cold water; next put the celery into a pot with a little gravy, or stock and water, enough to cover it; add pepper, salt, and a bunch of herbs; stew till it is tender; then lift carefully out of the pot and place it on a round of toast, cover with melted butter, and serve hot. The liquor in which the celery has been stewed must not be thrown away, add it to the stock-pot, and it will greatly improve the flavour of the soups or gravies which you will make from it. The outside leaves and trimmings ought also to be well washed, and added to the stock-pot; if not so used, they ought to be burnt in preference to being put into the dust-bin or ash-heap.

122. *Celery Soup.*—Take the outer leaves and stalks of a head of celery, cleanse them well. Peel two onions, one carrot, half a turnip; slice them, and put into a saucepan with one quart of stock, and one pint of water; add pepper and salt; let it all boil for one-and-a-half hours; pass through a wire sieve; mix it well with the liquor in which it has been boiled. There will now be about one quart. Put one table-spoonful of flour into a basin, mix with a little cold water until it is quite smooth, and sufficient water to make it into a thin batter. Put the soup back into the saucepan, taste it, and correct the seasoning, adding more salt if necessary. Let it come quite to the boil, and then stir up and pour in the flour mixture from the basin, stirring the soup during the time you are pouring it in. Boil for five or six minutes. Toast some bread in the meantime, cut it into dice, and serve on a separate plate, to be eaten with the soup.

123. **Cheese**: derived from the Saxon word *cyze*. It is a highly nitrogenous food, and is made from milk-curd, which is separated from the milk by means of rennet, which turns the *sugar of milk* into *lactic acid*, and produces the same effect (only in a stronger degree) which you would obtain by pouring a wineglassful of vinegar into a pint of slightly-warmed new milk. The curd thus obtained is washed and pressed. The

Dutch peasants' cheese-making is the simplest process known. They collect the curd, place it in wooden bowls or shapes, and weigh it down with heavy stones in lieu of the regular cheese press. This system of pressing causes the honeycomb appearance of the Dutch cheese. *Cream cheese* is made from the fresh curd of whole milk. *Colwick cheese* is made from skim milk, is a good imitation of cream cheese, and costs about one-third of the money; it is a capital relish for supper when ripe. *Cream cheese* is richer in fatty particles; *skim milk* is the most nourishing, and best fitted as an article of diet. Cheese is coloured principally with *Annatto*, and particular kinds of cheese are coloured with sage leaves, parsley, marigold flowers, carrots, saffron, seaweed, &c.; and varieties of substances, such as potatoes, &c., are mixed with the curd to impart flavour, &c.

124. *Cheese and Toast.*—Cut 2 rounds of bread from a stale loaf, toast it well and carefully; spread a little dripping over each slice whilst hot. Grate 2 oz. of American cheese, mix it with $\frac{1}{4}$ teaspoonful of black pepper and dry mustard mixed, spread evenly over the toast, put the slices one over the other on an old plate or baking-tin, and place in the oven ten minutes before you wish to use it. It must be eaten directly it is taken out of the oven.

125. *Cheese Sauce for Toast* (*or bread*).—Take 2 oz. of American cheese (about one pennyworth), cut it into slices and put into a clean saucepan with 1 dessert-spoonful of vinegar, pepper and salt to taste, and a mustard-spoonful of ready-made mustard, also half a teacupful of skim milk or small beer; toast some bread as in 124, stir the cheese in the saucepan over the fire, and when it is quite liquid pour over the slices of toast, which ought to be laid in a deep dish or soup plate. Eat whilst hot.

126. *Cheese balls.*—A nice little supper dish may be made from 2 oz. of cheese grated and mixed with any cold mashed potatoes, seasoned with pepper and salt and about 2 oz. of

bread-crumbs (or bread-crusts soaked in milk and squeezed dry); break an egg into a cup or basin, and whisk it for a minute, add half of it to the cheese, potatoes, and bread; flour a board, and form into little balls, dip in egg, and fry either in boiling fat or bake in a tin with dripping in the oven, turning the ball in the fat once or twice.

127. Take any cold potatoes that may be left from dinner (two or three), pass them through a wire sieve with a wooden spoon. Grate the same weight of cheese, season it well with pepper and salt. Put the potatoes into a saucepan with about a teacupful of milk. Place the pan near the fire. Make a little plain, short crust; line well-greased patty-pans. Then take a wooden spoon, and, stirring the potatoes and milk over the fire, thoroughly mix them. They should not be sloppy, boil until it is thick, then stir in the seasoned cheese, lift at once off the fire, and fill each of the little patty-pans. Place a very tiny bit of dripping on the top of each, and bake till it is brown on the top. They must be eaten as soon as they are cooked.

128. *Cheese and bread patties.*—Soak the stale crusts in water till quite soft; squeeze them quite dry; beat them up in a little milk. Prepare the cheese as in No. 126, whip an egg and mix with bread, then add the cheese. Line some patty-pans with paste; fill with this mixture, which ought to be about the consistency of bread-sauce; bake for half-an-hour.

129. *Cheese-cakes* (Yorkshire).—These cheese-cakes are to be found in every Yorkshire home, however poor. Farm labourers have them for breakfast and supper. They consist of curd, the great principle of which is casein. It rapidly supplies the waste of muscular power, and is to them what Professor Buckman describes the Dorset cheese to be to his farming men. Recipe: get twopennyworth of nice fresh curd, beat up two eggs and mix with it. Pick, wash, dry, and plump before the fire $\frac{1}{4}$ lb. of currants; mix them with the curd; also two tablespoonsful of moist sugar, and about three

drops of essence of lemon. (N.B. Twopennyworth of essence of lemon from the chemist will last a long time if properly used.) Line saucers or patty-pans with plain thick crust; put one tablespoonful into each patty; bake in a quick oven for quarter of an hour. Curd is expensive to buy or make in the Southern Counties, although the milk can be turned by alum or rennet, bought from the druggist.

130. **Collops minced.**—This is quite a national dish in Scotland. Take about one lb. of juicy lean gravy beef, mince it extremely fine, put it into a basin with sufficient water to cover it, and beat it with a fork till all the little granules are separated; then put it into a saucepan with a small lump of butter as large as a walnut, season with pepper and salt; next place it over the fire, continue to stir it with the fork till it comes to the boil, being careful to keep the grains separate. Let it stew for twenty minutes, and serve with mashed potatoes. It is nutritious and digestible, and an excellent method of disposing of tough meat and obtaining a luxurious delicacy at little cost.

131. **Cranberry** (*Oxycoccus palustris*).—A fruit of the same order as the *bilberry*, and known in some countries as the *mossberry*, or *moorberry*. It is indigenous in bogs and marshy ground, and is a valuable antiscorbutic. Large quantities are imported into this country from America and the Northern European countries. They make excellent preserves, delicious syrups and wines, and in cases of blood-purifying they are found very useful. The fresh gathered cranberries exposed for sale in our North and Scotch markets are preferable to those which are imported.

132. *Cranberry tart.*—Make a little short paste. Fill a pie-dish with freshly-gathered cranberries. Dissolve in a little water one tablespoonful of sugar, pour it over the fruit. Cover the pie-dish with paste, brush over lightly with milk, do not make the paste too wet, grate a lump of sugar over, and bake in a quick oven for half-an-hour.

133. *Cranberry jam.*—Take 7 lbs. of freshly-gathered cranberries, put them into a preserving pan with one pint of water; let it come to the boil, skim well; boil for half-an-hour; add 6 lbs. of sugar, and boil for three-quarters of an hour; skim well, and then put into *clean dry* jars or bottles; when cold, tie down with brown paper two or three thicknesses.

134. *Cranberry syrup.*—Boil 3 lbs. cranberries as in No. 133. Then put them into a bag made of a piece of white calico; squeeze them till all the juice is expressed. Put into a saucepan 2 lbs. lump sugar; add the juice you have taken from the cranberries; also one pint of cold water; boil, and skim the dark brown froth off until the syrup is quite transparent; bottle, cork, and *seal the top* of each cork. To cottagers whose children can gather the berries, this will be found an invaluable drink for them during the hot summer days, costing only the sugar and the trouble of making.

135. **Cucumbers** (*Cucumis sativus*).—Can be cultivated by cottagers in the South of England in the open air, with little trouble or expense. Three-pennyworth of seed and the trouble of making a bed, and covering up the young plants at night for fear of slugs, is all the trouble entailed, whilst the addition of a few jars of pickle, as a relish to bread and cheese, cold meat, &c., more than compensates for the time spent in their culture. Cucumbers may often be bought in the open markets at three a penny, but that is only when they are very abundant, and they are often more than over ripe. The skin is considered by some medical men as injurious, by others as simply indigestible, and some German doctor, writing on the subject, about six years ago, expounded a theory in one of his country's scientific journals, proving that cucumbers grown in green and hot-houses contained in the skin valuable elements, while those subjected to out-door cultivation contracted certain poisonous substances, which, however, like the poisons in the *cassava*, were dispersed by cooking.

136. *Cucumber and Onion Pickle.*—Slice about 4 lbs. of cucumbers, and peel and slice the same weight of onions; lay them on a large flat meat dish, cover them with $1\frac{1}{2}$ lbs. of crushed salt; let them remain on the dish twelve hours, drain and place in a large jar or wide-mouthed bottle. Boil sufficient vinegar to cover the pickle (about two pints and a-half will probably be ample), adding 2 oz. whole pepper, 1 oz. cloves, 1 oz. mace, 1 oz. bruised ginger. Let the whole boil for half-an-hour, strain and pour over the pickle in the jars whilst hot; repeat the same process, next pouring off the vinegar, and putting the spices to it again. After pouring the vinegar as hot as possible over the pickle, equally distribute the spices over the tops of the jars; see that the pickle is well covered with vinegar, and, when cold, tie down with three or four thicknesses of brown paper. This will be ready for use in a week or ten days.

137. *Cucumber Salad.*—Peel and slice a cucumber, also an onion (parboiled if preferred). Mix in a teacup two tablespoonsful of vinegar, with one teaspoonful of salt, one ditto of sugar, one ditto of ready-made mustard, and a little pepper, also one tablespoonful of salad oil, if it is liked; stir and mix well, then pour over the cucumber, &c. Garnish with cress and sliced radish.

138. *Cucumber Pickle.*—If the cucumbers are old and likely to be tough-skinned, peel them, cut into lengths of about two inches, halve or quarter according to the size of the fruit. If the cucumbers are young, boil in water for quarter of an hour with 2 oz. of salt for every lb., and a piece of alum as large as a walnut to green them; then proceed to slice, &c. Put them into jars; prepare a pickle as in No. 136. Let it become quite cold before adding to the cucumbers. Cover the jars with brown paper. The pickle will be ready in three or four days.

139. **Curry Powder.**—It has been argued that the introduction of curry powder into artizan cookery is a mistake, 'no

poor man could afford it.' I am quite certain that where he will eat it, the use of curry powder is an economy, and cheaper far than many of the sauces, mustard, and other condiments, which, although the rich may not always be aware of the fact, I frequently find used in cottages where one would least expect to see such aids to cookery. The use of curry is not at all hurtful if used in moderation, and will often make a dinner of vegetables as palatable as if meat were used. Indian curries are considered the best, and everyone who comes from India seems to have a different recipe. The recipe which I have found most successful was given me by a Singalese lady who was visiting in this country. The curry powder I use for Class-teaching is Crosse & Blackwell's, as I find it good, and of average strength.

140. *Curried and Stuffed Eggs.*—Put the eggs into a saucepan of boiling water, and boil a quarter of an hour; lift them at once into cold water, to preserve the colour of the yolk; shell carefully, cut a little lid off the broad end, scoop out all the yolk, and press it through a hair sieve; crumble some dried herbs; on another plate mince of any cold meat, ham, beef or mutton, one tablespoonful; add to the herbs, season with pepper, salt (and chopped boiled onion if liked), mix with half the yolks, make into a paste, and stuff the eggs; put a basin over the eggs, and put on a hot plate to keep warm a few minutes. Have ready the following mixture: 2 oz. apple, sliced; 1 oz. carrot, very thinly sliced; one shalot stewed tender with cloves and mace, bayleaf, thyme, parsley. Press all through a hair sieve. Put this all into a saucepan with a little sauce, and the rest of the yolk of egg, and one dessertspoonful curry powder, and stir till it thickens; add one teaspoonful of lemon juice. Arrange the eggs on a hot dish, standing on the cut open end, pour the sauce round, and serve garnished with toasted bread.

141. *Curried Fish.*—Prepare a curry mixture as above (No. 140), leaving out the yolk of egg, and adding one table-

spoonful of baked flour instead. Take any cold fish which may be left from any previous dinner, pull it into flakes and put it into the curry sauce. When quite warm, serve with toasted bread laid round the dish as a garnish. If the curry is liked *very hot*, add one teaspoonful of white pepper to the above mixture.

142. *Curried Meat.*—Prepare the curry as for fish, cut the meat into small dice, stew for one hour in sufficient stock to keep the meat well covered, then add the curry mixture, stew for another half-hour, stirring well now and then to prevent the curry from burning. Dish and garnish with boiled *rice.*

143. *Curried Rabbit.*—The tinned Australian rabbits are delicious curried, and are much cheaper than the English rabbits. Prepare the curry as for fish (No. 141). When it is thoroughly cooked, open the tin and carefully lay the rabbit into the curry in the pan ; let it remain about ten minutes in the sauce at the side of the fire ; dish carefully. Garnish with a wall of mashed potatoes.

144. **Currants.**—*Passulæ Minores* are a small seedless variety of grape dried in the sun. The berries are red or blue. They take their name from the Grecian City, where they were first known to be cultivated. They form a chief article of export from Greece and the Ionian Isles. *Zante* currants are supposed to be the best, but the island would not and could not grow all the Zante currants (?) offered for sale in the English markets alone. Currants when purchased *ought always* to be washed, picked, plumped, and dried before the fire, and then be carefully packed away in a box for use. If this were practised it would often save much time and labour. *Currant* is also the name applied to the fruit of the *Ribes* order, the size of the fruit being somewhat similar. They are the *Ribes rubrum* or red currant, of which the white is simply a variety ; the *Ribes nigrum* and the *Ribes sanguineum*, or flowering currant, are all used in cookery. Especially excellent are the leaves of the latter as a flavourer, whilst the fruit supposed by

the uneducated to be poisonous is really not so, but capable of being turned to very good account.

145. *Currant Dumplings.*—Shred $\frac{1}{4}$ lb. of mutton suet, mix it well with $\frac{1}{2}$ lb. of flour, add one teaspoonful of baking powder, one tablespoonful of sugar, $\frac{1}{2}$ teaspoonful of grated nutmeg, $\frac{1}{4}$ lb. of currants. Mix well together and make into a light dough with tepid water. Form into dumplings, and either bake or boil.

146. *Currant Cake* (Yorkshire).—Cover a large plate with paste, and leave enough paste to make a cover. Put 2 oz. of washed and picked currants into the centre of the dish, strew over the top one tablespoonful of sugar and a little grated nutmeg; also one or two drops essence of lemon, a piece of butter as large as a nut placed in little specks here and there. Cover with the paste and bake for half an hour in a brisk oven.

147. **Custard, Baked.**—Line a pie-dish with paste. Break an egg into a basin, blend it with the whisk, add $\frac{1}{2}$ pint of new milk, whisk it for a second or two to thoroughly mix, add one tablespoonful of moist sugar, two drops of lemon essence. Pour into the pie-dish and bake in a moderate oven for one hour.

148. Custard pudding, boiled, prepare as in No. 147, only line a greased *basin* with the paste *instead of a pie-dish;* put on a greased paper cap. Place the custard carefully into a saucepan with boiling water sufficient to reach within half-an-inch of the rim of the basin. Steam for $1\frac{1}{2}$ hours. This pudding is delicious eaten with stewed fruit.

149. **Coffee** (*Coffea Arabica*).—In this country the seeds or berry of this plant are roasted or ground, and either an infusion or decoction made from them. The former is the proper method, as the valuable principle, the *caffeine*, is lost in boiling. Coffee is good for people who suffer from sluggish action of the heart. It is a powerful brain-stimulator. In the East, the natives prefer the roasted leaves gathered just before the period of the flowering of the plant, but they lose their

strength, fragrance, and most valuable properties in transit, therefore we still continue to use the seeds.

150. *Coffee.*—Take two tablespoonsful of 1s. coffee, place it in a jug or coffee-pot, pour upon it one pint of *boiling water*, stir it and let it stand for ten minutes; boil one pint of skim milk, add to the coffee in the pot, and serve at once. Coffee should *never boil*, or the essential oils will escape and its best properties be lost.

151. **Date Pudding.**—Chop a $\frac{1}{4}$ lb. of suet very finely, put it into a basin with $\frac{1}{2}$ lb. of flour and 1 tablespoonful of sugar; stone and chop $\frac{1}{4}$ lb. of dates, mix with the flour and suet, drop in an egg, and add sufficient skim milk to work it up into a light batter; grease a pudding-basin and pour in the mixture. Steam for $1\frac{1}{2}$ hours.

152. *Dates stewed.*—Dates are almost as nice when stewed as *prunes*. Take $\frac{1}{4}$ lb. dates, put them into a saucepan with a teacupful of water, the juice and rind of half a lemon, about six cloves and a little lump of nutmeg. Stew slowly for half-an-hour; taste and see if the syrup is sweet enough; if not, add sugar to taste, lift out the dates, place them on a deep dish, and strain the syrup over. This should be eaten with boiled rice, corn-flour, &c.

153. **Dory** (*Zensfaber*).—This fish takes its name from the word *Dorée*, signifying golden or gilt, as it possesses a bright yellowish lustre. This fish was greatly esteemed by the ancient Normans, and at our own tables is considered a delicacy. John Dory is very plentiful on the Southern coast of England, and consequently very cheap, so it will not be out of place to give a few recipes for dressing it amongst the artizan cookery. If the fish is cheap you may safely buy a large quantity. Procure two pennyworth of *Acetic acid* from the chemist, put it into a basin with a half-pint of vinegar, take a small brush and brush the fish you require to keep over with the mixture, lay on a clean dry dish so that the fish do not touch each other, sprinkle a *little* salt over, or hang them on a stick in a shady

cool place without adding the salt, and the fish will keep some time.

154. *Dory, Baked.*—Clean the fish through the gills, trim the fins and spines, wipe the fish carefully; make a stuffing of bread-crumbs, suet, parsley, thyme, and a little dried lemon rind. Moisten with milk, stuff the fish through the gills, put it into a tin pie-dish with sufficient stock to half cover it, place one or two pieces of dripping on the top, add three cloves, a blade of mace, pepper and salt; bake for twenty minutes, basting the fish every now and again. Strain the gravy before sending to table. Crusts are very nice put into the liquor, and baked in it with the fish, especially where there are children.

155. *Dory, Grilled.*—Have a clear cinder fire, grease a piece of white writing-paper for each fish, chop an onion, a little parsley and thyme, and strew on the paper; clean and trim the dory as in No. 154; rub the bars of the gridiron with chalk; place the fish on the greased paper; sprinkle with pepper and salt, fold it neatly up, folding the ends in tightly, place on the grid, and grill over or in front of the fire. Make a little thick gravy to serve with the fish; be sure that it is nicely flavoured. When cooked, which will be in about ten minutes, take the fish up, send to table in the paper, and the sauce in a tureen.

156. **Duck,** *to bake or roast.*—I have seen cottagers treat themselves to a duck, and cook it in the most strange manner, and then declare that fat bacon was preferable. No wonder! A clergyman of my acquaintance found one of his very poorest parishioners frying a duck for dinner in a dirty frying-pan, and loudly exclaiming because it was burning outside and not doing in. The simplest method for cottagers to try, is to bake or roast it. We will suppose the duck carefully plucked; next cut the skin of the duck round near the head; remove the crop, and take off the neck close to the body; make an incision a little below the breastbone, and draw the bird.

Take some salt and rub down the backbone; then pour *boiling* water from the neck *through* the body, letting it run along the back, the brown substance or sole will then be easily removed; wipe the duck dry inside; steep the feet in *boiling* water, and remove the outer skin. I have seen some professed training cooks slovenly enough to stick the legs of fowls and ducks between the bars, but it is untidy and dirty, and ashes are not absolutely required as a coating to the breasts of poultry about to be cooked. Boiling water is the most correct method of freeing the skin from the flesh. Now light a piece of paper, hold the duck over the flame to singe off the hairs. Clean the giblets; cut off the beak from the head, and plunge the latter into boiling water; skin it, and put all these on in a saucepan to stew. Prepare a stuffing of either—

(A.) Three oz. bread-crumbs, one tablespoonful of chopped onion (put into a basin and scalded for ten minutes), one teaspoonful crumbled sage leaves. Drain the water off the onion; mix the bread, &c., with them; season with pepper and salt; moisten with milk, and stuff the duck. Truss carefully, turning the feet to rest on the back. Dust the bird over with flour; place it in a baking-tin; it will be done in one hour in a smart oven. Or—

(B.) Prepare the duck as above, and make the stuffing of potatoes and onions, peeled, sliced, and boiled together till quite tender; drain and pass through a wire sieve, add minced or powdered sage leaves and seasoning, mix well together with a fork, stuff the duck, truss and roast before a clear fire, basting well. Serve with good gravy made from the liquor in which the giblets have been boiled; green gooseberry or apple sauce can be sent to table with duck. The giblets will make a nice pie with a little piece of coarse meat.

157. **Dumplings,** *Suet.*—Are a very nice addition to dinner, and can either be baked or boiled. Mince $\frac{1}{2}$ lb. mutton suet, mix it with $\frac{3}{4}$ lb. flour, add one teaspoonful of baking powder, work into a light dough with water. Flour a board, form into

balls, and either bake or boil as preferred. If boiled, flour cloths, tie the dumplings up, and have a pot on the fire with boiling water; plunge it in and boil for one hour.

158. *Dumplings, Green Gooseberry* (Nottingham recipe).—Pick 1 lb. of green gooseberries, make the suet dumplings as in No. 157, mixing the gooseberries and one tablespoonful of moist sugar, one teaspoonful of ginger with it; tie up in a floured cloth and boil; serve with sugar and thickened milk as sauce. This makes a fine dinner for little people. Cherry dumplings, plum dumplings, &c., can be made in the same way, and form a nice change to boiled fruit puddings, besides being more substantial.

159. *Dumplings, Norfolk.*—Take 1 lb. of flour, put it into a basin with 1 heaped teaspoonful of baking powder, mix well, add a little salt; make a dough of this with a little tepid water, have a pot on the fire with plenty of *boiling water*, form the dough into round balls, pop them into the pot, but be certain the water *is* boiling before they go in, close the lid down, and do not lift it for twenty-five minutes by the clock. Dinner ought to be quite ready then, and the dumplings served *at once* with gravy, stewed fruit, treacle or preserves; they should be torn asunder with two forks; they will not be light if cut with a knife.

160. *Drop Pudding.*—Prepare a batter as in No. 59, grease a baking-tin and pour it in. Take any kind of ripe fruit, such as gooseberries, currants, damsons, or plums, and drop them into the batter; bake as for ordinary batter, and serve with sugar and milk or thick milk for sauce. N.B.—In winter, rasins or currants can be substituted.

161. Dulse.—*Rhodomenia palmata* is a very common sea-weed used as food by the poor living near the coasts of Scotland, Wales, and South-west of England, and I believe also in some parts of Ireland. It is said to be a great antiscorbutic, and to those who have much fish diet, especially salt fish, it is a wholesome and excellent corrective. In Scotland

I have seen it used in the houses of the upper classes as a semi-medical resource, jelly being made from it, and the raw dulse being eaten at breakfast in the same way as mustard-and-cress or water-cress in England; but it is an acquired taste. The jelly is made by stewing for a long time in milk, and treating it in a similar manner to Irish Moss. The perfume of fresh dulse is very agreeable.

162. **Destroying Flies.**—Flies are particularly tormenting to cooks; the great question is, how to get rid of them, and better still, how to prevent them? Flies, the large bluebottle especially, always indicate the presence of decaying or putrid matter, animal or vegetable. See that your *dust-bins* are really what they pretend to be, and not the receptacle for waste cabbage-leaves, pea-shells, radish tops, turnip-tops, potatoes, and the like. Keep your sinks and drains sweet. *Look over the larder every day* and turn out the corners. Let no little bits of meat lie about, and do not spoil ten or fifteen shillings' worth of meat for the sake of three-pennyworth of lime or whitening to wash the walls of the kitchen or larder every four or six months. Brush all meat and fish and ducks over with acetic acid and vinegar mixed, during the very hot weather. These are the preventives. The cure is to boil 1 oz. of *quassia chips* in one quart of water till reduced to a $\frac{1}{4}$ pint, add one wine glass of old ale and one tablespoonful of treacle. Place it in saucers, and burn the flies as they are caught. This mixture is perfectly harmless.

163. **Dock leaves as greens.**—Gather the young tender leaves of the dock in the spring. Wash carefully in water, and put into a pot, with *boiling* water, a teaspoonful of salt and lump of soda as large as a pea. Cook with the lid off, pressing down the greens every now and then under the water; boil for twenty minutes. Drain on the steel wire sieve, press all the water thoroughly out and eat with roast meat, or give to the children with gravy.

164. **Eels** are not unlike serpents. They take their name from the Saxon *æl*; there are various species—sand eels, mud eels, conger eels, all good for table purposes; the first are the most delicate, the latter most nutritious, when fresh and not salted.

165. *Eels* (*Sand*), *to fry*.—Skin the eels by cutting the skin close round the head, and drawing it down over the body; cut it into lengths of about 3 inches. Beat up an egg, grate some bread-crumbs, and dip each piece of the eel first in flour, then in the egg, and toss in the bread-crumbs. Fry in boiling fat till each piece is a delicate bright brown; drain on kitchen paper. Pile on a clean napkin, or white cloth, and serve quickly.

166. *Eels* (*Mud*), *stewed*.—Skin and cut the eels into lengths of about 1½ to 2 inches, wash thoroughly in salt, and water and drain. Put the pieces into a saucepan, cover with water or second stock, add six cloves, one onion finely minced, salt and pepper, stew *slowly* for 1½ hours. Then put into a basin one tablespoonful of baked flour; moisten it with water; mince one tablespoonful of parsley, stir in the flour and water and parsley, let the stew boil for five minutes, stirring the whole time. Serve in a deep dish.

167. *Eels* (*Conger*), *to boil*.—This is quite a delicacy if properly cooked. Soak a middle cut of conger eel in strong salt and water two hours, take it out, wash and clean; have a pot with boiling water on the fire, place an old plate in the bottom if you have not a perforated tray, and tie the fish in a clean cloth. Put one tablespoonful of vinegar into the water, and a lump of salt as large as a walnut. When the water quite boils again, put in the fish; boil gently till the flesh seems free from the bone, then lift the pot off the fire. Leave the fish in the water for two or three minutes, then lift carefully up, untie the cloth, and place on the dish for table. Serve with melted butter and parsley poured over.

168. *Eel*, *Baked*.—Conger eel may be baked as in No. 51,

first soaking it in the salt and water, and then proceeding in every respect as for ling.

169. **Eggs and Bacon.**—Fry the slices of bacon first, then lift them out carefully on to thin, delicately-toasted squares of bread. Put this in the oven with the door open, or on the top, covered down with a plate; break the eggs one by one into a tea-cup. Having broken the shell, be careful to slip it gently into the tea-cup, so as to preserve the yolk whole; next slip it from the cup into the *boiling fat* in the frying-pan; cover the surface of the pan with eggs, and with an iron spoon baste them well with the boiling fat. Take a penny egg-slice, and lift each egg carefully out on to the bacon. If properly basted, the surface of the egg will be quite white.

170. *Eggs, Poached.*—Prepare some toast, and butter it, place it on a plate. Put on the fire a shallow saucepan with boiling water in it, a teaspoonful of vinegar, and a little bit of salt. Break an egg carefully into a cup, and slip it into the saucepan of boiling water, be careful not to drop from a great height, or the yolk will be broken; boil for two minutes, then lift carefully on to the toast, dust a little white pepper on the top, and serve hot.

171. *Egg Fritters.*—Boil an egg hard (for half an hour), lift it out of the boiling water, and place it in a basin of *cold* water *at once* to preserve the golden colour of the yolk, and cause it to shell more readily. Prepare the batter as in No. 57, adding sugar instead of savoury seasoning. Then shell the egg, cut it into thin rings, dip into the batter, fry in boiling fat, drain on thin wrapping paper (kitchen paper), and let them be eaten hot, with stewed fruit. One egg will make ten or twelve good-sized fritters.

172. *Egg Salad.*—Eggs boiled for half an hour or an hour are perfectly digestible. Therefore, all hard-boiled eggs should be given plenty of time to boil. Boil two eggs quite hard, slice them after steeping, as in No. 171, slice a Spanish onion in thin slices, place on a dish, sprinkle with salt and pepper,

pour a little vinegar over, to which has been added half a teaspoonful of sugar.

173. *Eggs in Cheese Sauce.*—Boil the eggs as in No. 171, shell and slice them. Prepare the toast and sauce as in No. 125. Before pouring the sauce over the toast, lay in the slices of egg, let them remain in the hot sauce five minutes, lift each slice out with a spoon, lay on the toast, and pour the sauce over. To be eaten as soon after dishing as possible. N.B. — This applies to all dishes in which cheese is an ingredient.

174. *Eggs, Stewed, and Cheese.*—Boil the eggs hard, put them at once into cold water, after a few minutes shell them and put them into a stewpan with some good well-seasoned stock; let them boil quite twenty minutes; lift the eggs on to a round of toast cut in half; boil the stock with a few peppercorns, cloves, a tiny bit of lemon rind, until it is reduced; then strain over the eggs. Have ready grated 2 oz. dry cheese, strew over the eggs, put pieces of butter here and there, and brown in the oven; serve hot.

175. *Eggs, Fried, and Cheese.*—Boil two eggs hard, shell, cut each egg into about six slices, fry a light brown, put on toast which has been buttered, grate 2 oz. cheese, season with pepper, pile over the eggs. Put pieces of butter or dripping in little tiny pieces here and there, brown before the fire or in the oven; serve hot.

176. *Eggs and Spinach.*—Boil and dress the *spinach* as directed under that head. Poach the eggs as in No. 170, and place carefully on the spinach. Eggs may be served on mock spinach by using lettuce, nettle tops, or cabbage sprouts, in either case very well boiled.

177. **Fat.**—In many households there is a great waste of fat and grease; careless or dirty cooks will skim off the oil rising to the top of the soup and throw into the fire that which ought to be collected. Small bits of fat taken off mutton chops, left from breakfast bacon, or trimmed off a joint of cold

meat when preparing to stew, &c., ought to be most carefully collected and cut into tiny dice, put into a large saucepan, or, better still, stewpan, covered an inch deep in water, and boiled well till the fat loses the muddy appearance and becomes quite golden, and the little scraps brown; then strained through the wire sieve into water. Even these scraps may not be wasted; they make excellent little baked puddings and pies.

178. *Fat to Clarify.*—In the above remarks, I gave you a recipe for *rendering fat.* To clarify, take any small quantities of dripping there may be collected together with the fat in your fish or frying stewpan or kettle, melt it, and strain through a wire sieve into a large clean pan, adding an equal quantity of cold water, and let it boil till all the water has evaporated; this you will know has been accomplished by the fat becoming perfectly still and the spluttering noise ceasing. Have ready a strong earthenware bowl half filled with water, strain the fat into the water through the wire sieve, let it stand till cold, remove the cake of fat, scrape the under side free from all black specks and impurities, and it will be fit for use.

179. **Frying.**—I would again remind the student that *frying is nothing more nor less than boiling in fat*, and that to fry properly no article of food to be so dressed ought to be put into the frying-kettle until the fat is thoroughly boiling; that is, when it is *perfectly still*, having neither noise nor movement. Always test the heat of the fat by a crumb of bread. After cooking, instantly remove the fat off the fire; do not leave it to burn and brown whilst you are dressing and garnishing the dish, or the fat will be spoilt by burning; it might take fire, and so do great damage and mischief. Never pour water into *boiling* fat or the consequences caused by the act may be serious, as the fat will jump and splutter.

180. *Frying Beefsteaks.*—See that the beefsteak has hung for a day or two before cooking. If it is freshly killed place it in vinegar for twenty minutes to soften the fibre. At the end of that time wipe it carefully, dust it over with flour and pepper

mixed, then see that the fat in the deep frying-pan is, first, sufficient to cover the steak, second, boiling. If so, put in the steak, fry till it is a nice brown on the outside, and have ready a couple of potatoes cut into thin rings. When the steak is done put the potatoes into the frying-basket, plunge them into the boiling fat, fry till they are a golden brown, drain them and sprinkle salt over, then place as a garnish round the steak. Chops should be fried in the same manner after removing the spare fat, boning, and trimming.

181. **Fig Pudding.**—Chop very finely ¼ lb. figs, also ¼ lb. suet, put these into a basin with six ounces of bread crumbs, one tablespoonful of flour, and one raw carrot grated; moisten with a little milk, add a tablespoonful of sugar, grease a basin, put in the mixture, grease a paper and put over the top. Place this in a saucepan with sufficient water to come half way up the basin or within one inch of the top of the basin. Let it boil for two-and-a-half hours. Serve with thickened milk.

182. **Fish to Fry.**—Wipe the fish carefully, dip it into flour, and then in an egg broken into a plate and beaten up a little, toss in bread crumbs, which should be placed in clean paper for the purpose, and put into boiling fat. Fry till they are a golden brown. Drain on paper, sprinkle with salt, and serve on a clean cloth.

183. *Fish Cake.*—Carefully separate into flakes any cold fish that may have been left from the previous day's dinner, free from bones; if the pieces are very large, halve or quarter them, pass through a wire sieve ½ lb. of cold potatoes (if there are none left, boil ½ lb.), season them with pepper and salt, add ¼ lb. stale bread crumbs or crusts that have been soaked in water. If the crusts are used wring them dry in a cloth and mix with the fish and potatoes; add one egg. Form into flat cakes, dip in flour, and fry a golden brown. If an egg can be spared for the outside so much the better; strew each cake over with a few bread crumbs in this case.

184. *Fish, Potted.*—Take any cold fish, mince it very finely with a sharp knife, season it with pepper and salt, a little grate of nutmeg—only a suspicion of it—and a little powdered mace. Press it into a little glass butter-cooler or oval ware dish; run a little clarified dripping or butter over the top. This is excellent with bread for a breakfast, luncheon, or supper dish, or as a quickly-made extra dish for a meat tea.

185. *Flounders to Fry.*—Choose nice fresh, bright-looking fish. Wash and wipe them dry, dredge them with flour, dip in egg, and then toss in bread crumbs. When the fat in the kettle is boiling, then place the fish in the basket, plunge it into the fat (or oil), and when the outside is a nice golden brown the fish will be ready. Drain it on kitchen paper and sprinkle with a little salt. The proper garnish to fried fish is *fried* parsley. It is simply ignorance, or, worse still, slovenliness when cooks do not fry the parsley, but dress fried fish, cutlets, rissols, &c., with uncooked parsley.

186. **Flummery.**—This is a dish that is much appreciated in some of the North-west coast towns of England. The people consider it a good food for children or delicate people: $\frac{1}{4}$ lb. of oatmeal is taken, put into a clean jar or basin, with one quart of cold water. It is placed on the hob near the fire and stirred frequently, until it has turned quite sour. It is then boiled like porridge, and eaten with new milk.

187. **Frumety or Firmety.**—Bruise 1 lb. of wheat with a rolling-pin or wooden mallet to remove the outer husk, and slightly crush it. Put the wheat into a jar into the oven, with three pints of skim milk, or one pint of milk and half-pint of water; let it cree for twelve hours, stirring now and then, and adding more water as the wheat may require it. This will keep a week or so. To USE for table—Take three spoonsful of the cree, mix it with half-pint of new milk, add one tablespoonful of white moist sugar, half teaspoonful of mixed spice, and one tablespoonful of raisins. This is delicious, made of new corn, and makes a capital dish, hot or cold, for summer

use. In the North of England this is used as a Christmas dish.

188. **Fruit Pies.**—Fruit pies require careful preparation, so that the fruit may be thoroughly cooked as well as the pastry. Cottagers' ovens are not always very good, and although the crust may be done to a turn, it is often found that the contents of the pies are half raw. This is particularly injurious to people of delicate constitution or weak digestion. If it is once found that the fruit will not cook in an oven, parboil it before putting into the pie-dish, and place a cup, tiny tumbler, or broken egg-cup in the centre so as to prevent the paste sinking in.

189. *Fruit Puddings.*—Soak ¼ lb. stale crusts in cold water for two hours; place a plate with a weight on the top of the crusts to keep them under. Whilst they are soaking, pick the fruit, and mince ¼ lb. mutton or beef suet. Wring the crusts dry in a clean cloth, put them into a basin with the chopped suet, two tablespoonsful of flour, one teaspoonful of baking-powder, and a pinch of salt. Mix well and lightly together, just adding enough water (if required) to make a nice light dough. Roll lightly and quickly out. Line a greased basin, half fill with fruit, then put in the necessary sugar, one or two tablespoonsful, according to the character of the fruit, *i.e.*, whether sweet or acid; pile the rest of the fruit well up, cover with the paste, grease a piece of clean wrapping paper, and put the basin into a pan with boiling water reaching to within one inch of the top of the basin. This crust is much lighter, more digestible, and cheaper than the ordinary pudding-crusts, besides being a method of using up old crusts—always a matter for the consideration of good housekeepers.

190. *Fruit Stewed for Children.*—Take three or four pounds of fruit, place it in an earthenware jar with two tablespoonsful of sugar for every pound of fruit, pour over all the fruit one teacupful of water, put any crusts of bread on the top, place in a slow oven, and stew for three or four hours. Dish up by

lifting out the bread first into a deep vegetable-dish or large pie-dish, then pour the fruit and syrup over.

191. *Fruits, Mashed.*—Strawberries, currants, plums, bilberries, cranberries, &c., are often eaten abroad mashed with or without breadcrumbs for breakfast, and fruits like the apple grated and then whipped. Nothing can be more wholesome than this preparation of fruits, and the making gives no trouble. The fruit is generally passed through a wire sieve, a wooden spoon or presser being used for the purpose; the penny wooden potato-mashers used in the North and Midland Counties are just suited for sieve pressers. When the fruit is through, ½ lb. of breadcrumbs are lightly whisked in, a silver fork or wooden salad fork being used for the purpose (steel ought not to touch the fruit); then sugar is sprinkled over and the fruit piled high in a dish. This is eaten with bread or thin strips of toast, and is a fine cure for dyspepsia if used for breakfast with brown bread and a glass of fresh cow's or goat's milk.

192. *Fruit Fritters.*—A cheap and nice method of using large ripe fruits is by making fritters. Slice the fruit, such as pears, peaches, plums, oranges, apples, &c., into thin rings or slices, and lay on a plate so that the slices may be easily lifted out. Then make the batter of one tablespoonful of flour made into a thickish batter with tepid water and milk in equal proportions, add one tablespoonful of crushed lump-sugar, whip the white only of an egg to a stiff froth and stir into the batter, dip the slices in, turn them in the batter and plunge into boiling fat; fry till they are a nice brown, lift out with the wire spoon, drain on kitchen paper, pile on a dish, sprinkle over with sugar, and serve hot. Strawberries are excellent cooked in this way.

193. **Flour.**—The flour in most general use in this country for making bread, pastry, &c., is wheaten flour. The great thing is to get the flour pure and free from such adulterations as plaster of paris, &c. The best method of obtaining pure flour is to grind the corn at home in your own mills; they

cost from about 6s., and can be had at 429, Oxford Street, London. *To test flour* there are one or two easy methods: the first is, to take a handful of flour, squeeze it tightly in the hand, and then open out your hand; and if the impression of the fingers is still on the flour, and it does not break or fall apart, that is a sign that it is tolerably free from foreign substances. Again, wet a small pinch of flour, take it between the finger and thumb, if it is glue-like and will draw into a long thread, the flour is fair; a little practice with different kinds of flour will soon teach the student to apply this test with precision. Again, if the flour is adulterated with chalk, plaster of paris, whitening, &c., place one tablespoonful of the suspected flour in a teacup, pour in a few drops of acetic acid or strong vinegar; if it effervesces there is adulterating matter in the flour.

194. *Flour Porridge.*—Take two tablespoonsful of flour, mix them into a smooth thin batter with a little cold water and half a teaspoonful of salt. Have on the fire to boil one pint of skim milk; just as it reaches boiling point, and begins to rise in the saucepan, pour in the flour mixture; stir well till it thickens. Let it boil for ten minutes to cook the flour; pour on to plates and eat with sugar, treacle, new milk, or fresh fruit mashed as in No. 191.

195. **French Beans, Italian fashion.**—Prepare the beans as in No. 69, drain them on a wire sieve; put into a saucepan a lump of dripping as large as a walnut, a small onion chopped very finely, also minced thyme, and any other garden herbs that may be at hand, fry the herbs, &c., in the butter till they are cooked a little, then turn in the beans. Stir them round with a wooden spoon so that they become thoroughly mixed with the contents of the saucepan; sprinkle over with pepper, salt, and cayenne; serve on squares of buttered toast. This is eaten without meat, and forms an excellent method of dressing the vegetable for dinner or supper where meat is not required.

196. **Fricasse of Beef.**—Take half a pound of gravy beef from the neck (sticking part), cut it into neat slices, dip it into vinegar, and let it lie for twenty minutes. Then dry, flour the slices, taking care that every portion is well covered with the flour. Fry the meat in plenty of boiling fat until it is half done. Place the meat in a stewpan with a small onion, two cloves, a little parsley, thyme; add one pint of second stock, or liquor in which meat or bones have heen boiled, and let it stew for an hour and a half. Thicken the gravy with baked flour, season with pepper and salt, and a little bit of lemon-rind. Arrange the beef neatly on a dish, strain, and pour the sauce over. N.B.—Cold beef may be used for this, but it must only *simmer* for about ten minutes or a quarter of an hour in the gravy before it is thickened.

197. **Fricasse of Rabbit.**—Cut the rabbit into neat joints. If an *old rabbit*, lay it in vinegar for twenty minutes. Take it out, flour it well, and fry for about five minutes in boiling fat, drain and put it into a stewpan with three cloves, six whole peppercorns, salt, a small onion shred finely, thyme, marjoram, and parsley, about one teaspoonful when chopped, one small slice of carrot, and one of turnip, let it stew slowly in stock (on no account use water; every careful housekeeper will have plenty of stock) sufficient to cover it for an hour and a half. When it is nice and tender strain off the stock, and put it into a clean saucepan to boil. There should be about two teacupsful of the gravy. Have ready mixed in a basin one tablespoonful of flour, and half ditto of cornflour mixed to a batter with a little milk; pour this into the gravy, stirring the latter till it thickens, taste it and season properly; let it boil five minutes to cook the flour. Arrange the rabbit neatly on the dish; pour the hot sauce over and serve at once.

198. **Garlic.**—The common garlic *Allium sativum* is the chief of our onion tribe, and the various species such as the onion, *Allium Cepa;* the leek, *Allium Porrum;* the shalot, *Allium Ascalonicum;* chives, *Allium Schœnoprasum*, are all

more or less used in this country for cookery. The garlic itself is divided into cloves. It is very pungent. The aroma and flavour are imparted by an oil known as *sulphide of allyle.* Abroad, the garlic is found in every savoury dish.

199. *Garlic Vinegar.*—This is much employed abroad, and for those who like the flavour of garlic it is an inexpensive and economical method of keeping garlic flavouring. Take one bulb of garlic, break it into cloves, peel them and cut each into two, put them into a perfectly *clean, dry* bottle, boil one pint of vinegar for ten minutes, or quarter of an hour, pour it over the garlic, cork the bottle at once and seal it. It will be ready for use next day. *One drop* is sufficient to flavour a salad, and less will impart a delicate aroma to sauces where onion is liked.

200. *Garlic Pickle.*—Put into a saucepan sufficient water to cover the quantity of bulbs you wish to pickle, add sufficient salt to make the water into a strong brine, in which an egg will float. Let it boil, and in the meantime place the bulbs into an earthenware pan; pour the boiling brine over, let it become *quite cold* and then peel them out of the brine and place them in *dry* bottles or jars. This method will greatly preserve the eyes during the operation of peeling. When the garlics have all been peeled, see that each jar has about one inch from the neck free so that the vinegar may quite cover the cloves. Put into a saucepan sufficient vinegar to cover the pickle, and to every quart of vinegar add 1 oz. of whole black pepper, ½ oz. pimento or long peppers, ½ oz. horseradish, ½ oz. bruised ginger, ½ oz. mustard seeds; boil for 20 minutes, strain over the garlic. The spices will do for other pickles if steeped in vinegar six hours and boiled as before directed.

201. **Garnishes** are always a subject of consideration for the good cook. Parsley is the most common form of garnish used, and is sent to table in its natural state for cold meats, butter, cheese, &c., but it *must be* fried when sent to table with fried meats, and minced when intended to garnish hot vege-

tables, or any warm dish. It shows a great amount of ignorance on the part of a cook who either neglects this or really does not know it. It is as well in every house where there is a garden attached, or means to carry out the plan, to identify certain dishes with different garnishes. For instance, garnish cold fowl with *watercress*, cold ham with young *carrot tops*, which are feathery and light, cold fish with fennel or asparagus leaves. In fact there are multitudes of garnishes for cold dishes without always resorting to parsley. Sliced *lemon* cut in half, and almost quartered, is used as a garnish for hot or cold fish, curries, veal, fowl, turkey, and all white meats.

202. **Pickled Oranges and Lemons.**—Put the lemons and oranges into separate brine pickles, strong enough to float an egg. Let them lie in it for three days; drain and put into dry bottles. Prepare a pickle of white wine vinegar in which has been boiled 1 oz. mustard seed, 1 oz. whole pepper (white), 2 oz. bruised ginger, 1 tablespoonful white sugar; strain and add to the lemons and oranges when quite cold. Keep the fruit in separate and distinct bottles, so that the oranges may not colour the lemons—but serve together at table. Fit for use in six months. Currant jelly, mountain ashberries preserved, and barberries are used as garnish, and eaten with game. Sliced beetroot is used with cold boiled beef, and forms a very pretty garnish if prettily cut out into shapes, &c., and contrasted with a little white turnip, and relieved with something green. The over-dressing of dishes is as much to be avoided as sending them to table without any decoration at all.

203. **German Pancake.**—Take any stale slices of bread, soak them in cold milk for ten minutes, put into the frying-pan one ounce of dripping, let it become boiling hot, beat up an egg, dip each slice of bread in the egg, or brush it over, cover it thoroughly, fry a golden brown in the fat, place it on a dish, spread some home made preserves over, and it will be found to be a dish fit for a king, besides disposing of the stale

bread. The egg may be diluted with a dessertspoonful of milk.

204. *German Pudding.*—Toast some slices of stale bread quite brown, say two, put them into a pie dish with a layer of jam between, make a cold custard of one egg, well beaten, and sufficient milk to fill the pie-dish: also one tablespoonful of moist sugar; mix all well together, and pour over the toast in the pie-dish; let it stand for twenty minutes or half an hour before baking, then put a little piece of nice dripping on the top, and bake brown.

205. **Giblet Soup.**—Buy a set of nice giblets, wash them well, add 1 lb. of bones, and simmer for four hours with an onion, bunch of sweet herbs, pepper and salt. Remove the bones, which will do boiled again as second stock to use for pies, hash, or gravies, and is preferable to cold water. Cut the giblets into little dice. Mix in a basin one tablespoonful of baked flour, one teaspoonful of caramel, and sufficient water to make it into a batter; put the soup and giblets back into the saucepan, let it come to the boil, stir in the thickening, stir till it again boils, taste, correct the seasoning by adding what may be deficient; serve with toasted bread on a separate plate.

206. *Giblet Pie.*—With a set of giblets buy either 1 lb. of ox cheek or 1 lb. of shin of beef. Clean the giblets thoroughly and if they are goose giblets soak them in salt and water for half-an-hour; this will take away any strong taste. Cut the gizzard into four slices, the heart in two, plunge the pinions into boiling water and with a knife remove the pen feathers. If there is a head pour boiling water on it also, and skin it, then split it open, remove the eyes and take off the beak by chopping. Cut the ox-cheek or shin of beef into neat little pieces the size of the slices of giblet, dip each piece in a mixture of one table-spoonful of flour, one tea-spoonful of salt, half a tea-spoonful of black pepper. Put all the pieces into a stew-pan and stew slowly for two hours covered with second

stock. Have ready a pie-dish and some plain dripping paste, and when the giblets and meat have stewed the proper time place all in the pie-dish, cover with paste, and bake for half-an-hour.

207. **Ginger** is the creeping stem, or rootstock, of the *Zingiber officinale.* The plant is reedlike in structure, possesses a powerful essential oil and a kind of resin, both of which are imbued with excellent qualities. Ginger is a strong stimulant, powerful sialogogue and stomachic. It is cultivated in the East and West Indies for market use, and is barked before being sent to market.

208. *Ginger Cakes.*—Beat ½ lb. dripping to a cream with a wooden spoon, beat in 1 oz. of ground ginger, and ½ lb. moist sugar; add one egg and 1½ lb. of dried and sifted flour. The flour must be dried in the oven and passed through the wire sieve. If the flour is good, it will require no liquid in the mixing, but if it does, add a little water. Flour a baking-tin, and place the ginger cakes in little rough heaps. Put them into a very quick oven so that they may set at once, and not spread over the baking-tin. One tea-spoonful of baking powder makes the ginger cakes nice and light.

209. *Ginger Pudding.*—Four oz. of bread crumbs, 3 oz. of suet well chopped, one tablespoonful of ground ginger, two tablespoonsful of moist sugar. Mix all the dry ingredients well together. Beat up an egg with a cupful of milk, mix with the other ingredients, pour into a well greased basin, grease a piece of clean wrapping paper, place over the top, tuck in the edges of the paper, and put into a saucepan with boiling water sufficient to come within one inch of rim. Boil for two hours and serve with stewed fruit or thickened milk.

210. *Gingerbread Squares* (Scotch recipe).—Put 2 lbs. of coarse oatmeal into a basin, strew over it and mix in one tea-spoonful of baking powder. Make a hole in the centre. With ½ lb. of treacle, mix ½ oz. of ground ginger and one teaspoonful of mixed spice, and ½ lb. of melted dripping. Now pour it

into the hole, and stir the whole into a stiff dough with a wooden spoon or round stick. Grease a baking-tin, flour a paste-board, place the dough on the board, and roll it out to half-an-inch in thickness; brush it over with egg; cut into squares of three inches each way, lift carefully on to the tin, bake for three-quarters-of-an-hour. This is a useful sweet-cake for children, as it may be made the vehicle for introducing medicines, such as cod liver oil, simple aperients, &c., which are covered by the ginger.

211. *Gingerbeer Powders.*—A $\frac{1}{4}$ lb. of lump sugar reduced to a fine powder, one oz. carbonate of soda, $\frac{1}{2}$ oz. powdered ginger; mix this well, and put it into twelve equal parts, in twelve separate papers, on which write at once the No., 1. Take $1\frac{1}{2}$ oz. tartaric or citric acid, divide it also into twelve equal parts, and number the papers 2. To use, dissolve the contents of No. 1 in a glass three parts full of water; then stir in No. 2, and drink whilst in a state of effervescence.

212. *Gingerbeer* (American recipe).—I have to thank Messrs. Collins Bros., of New Jersey, for the following excellent recipe for gingerbeer. Put into an earthen pan 1 lb. of lump sugar, $1\frac{1}{2}$ oz. bruised ginger, lemon sliced and the pips extracted, also $\frac{1}{2}$ oz. of cream of tartar. Pour one gallon of boiling water over. When it is milk-warm take a whisk and beat in vigorously $\frac{1}{4}$ pint of brewer's yeast, or 1 oz. German yeast mixed to a liquid with powdered sugar. Whisk it well, cover with a cloth, let it stand for fifteen hours, skim off the top, strain through a piece of an old tablecloth or dinner-napkin; bottle. If it is liked, after skimming, merely stir and bottle without straining; thus it can be either clear or with the ginger, as preferred. In bottling, only half fill the bottles.

213. **Goose, roast.**—Pluck the goose carefully, reserving the feathers for after picking and drying; singe carefully by lighting a piece of kitchen paper and holding the goose over it; draw and wash in warm water. Make a seasoning of 3 oz. stale bread crumbs, half teaspoonful of salt, half ditto of

pepper, 1 oz. of parboiled onions, and 1 teaspoonful of dried and powdered sage leaves. Truss and place a greased paper over the breast. Roast for $1\frac{1}{2}$ hours. If the goose is large, serve with apple sauce. In Ireland they frequently stuff the goose with mashed potatoes and onions; seasoned with salt and pepper it is excellent. Baste well during the roasting, and prepare good brown gravy.

214. *Goose, Mock.*—Take four fresh hocks of pork, the portion of the leg above the foot; they will be very cheap. Score them as you would a leg or loin of pork; next bone them with a sharp knife, or if you cannot find time to perfectly bone them, loosen the flesh round the bone; prepare a nice stuffing as for goose, No. 213, press it well in between the meat and the bone, roast for about one hour, or bake for the same time in a quick oven, basting well. Serve with apple or gooseberry sauce. Even salted hocks are nice treated in this manner.

215. **Gooseberry.**—An indigenous plant in this country. *Ribes Grossularia.* It is the same genus of plant as the currant. Cultivation has wonderfully improved the fruit, of which there are many varieties. It is a very wholesome fruit and is largely employed in making preserves, mock champagnes, as well as for general domestic purposes. In fact, a great deal of sparkling gooseberry wine is sold in this country as champagne at very high rates.

216. *Gooseberry Fool.*—Take $1\frac{1}{2}$ lbs. of gooseberries, pick them, scald them by putting them into a saucepan with a little water, let them come to the boil. If green berries they must cook a few minutes; pass them through a wire sieve. Sweeten the pulp, and put on one side until they are a little cool, put a pint of new milk in a clean pan on the fire to boil with two lumps of sugar and a tiny lump of nutmeg as large as a cherry stone; when it has boiled, remove the nutmeg and mix gradually with the gooseberry pulp. Stir well, or rather beat well, until it is nearly cold; place in a glass dish for table.

217. *Gooseberry Pudding.*—Pick $\frac{1}{2}$ lb. of green gooseberries, mince $\frac{1}{2}$ lb. mutton suet, mix them both with 1 lb. of flour, one teaspoonful of baking-powder and one teaspoonful of moist sugar; mix with enough water to form the whole into a firm dough. Mix with a knife; do not touch with the fingers more than you can help. Grease a basin well with a piece of kitchen paper, as a medium between the dripping and the fingers; drop in the dough; grease a piece of clean paper, place over the top of the pudding, and place the basin in a saucepan containing sufficient boiling water to reach within one inch of the top of the basin. Steam thus for $1\frac{1}{2}$ hours; serve with thickened milk.

218. *Gooseberry Pudding.*—When gooseberries are plentiful, a suet crust may be made of $\frac{1}{4}$ lb. mutton suet minced finely, one teaspoonful of baking powder mixed with it, and a $\frac{1}{2}$ lb. of flour. Form into a paste with tepid water; grease a basin, line it with the paste, reserving enough for a cover, half fill with gooseberries, then add one tablespoonful of sugar, put in the rest of the berries, cover with the paste, wetting the edges round first so as to make the paste adhere and prevent the syrup from boiling out. Grease a piece of clean paper and boil as directed in No. 217.

219. *Gooseberry Drop Pudding.*—Pick $\frac{1}{2}$ lb. of ripe berries, make a batter pudding of two tablespoonsful of flour put into a basin, one egg dropped in and one teacupful of milk added by degrees until these ingredients are made into a smooth batter; now add another cupful of milk, one teaspoonful of sugar. Have ready in the oven a dripping-tin with 1 oz. of good dripping melted in it, pour in the batter; drop in the berries quickly and place in the oven to bake for fifteen or twenty minutes.

220. *Gooseberry Jam.*—I have myself used this recipe for more than ten years and have always had excellent keeping jam. Pick the berries, weigh and put them into a preserving pan with one teacupful of cold water, let the fruit boil for one

hour, skimming well and carefully, At the *end of the hour* add $\frac{3}{4}$ lb. of sugar to every pound of fruit, boil for another hour, then pour into clean dry pots, and when cold tie down with two or three thicknesses of brown paper.

221. **Gravy.**—It is a general complaint that much otherwise good cooking is spoilt by the gravy sent to table. A leg of mutton or roast of beef is apt to suffer much from the hands of an incompetent cook when she sprinkles salt over the joint, saturates and washes it with warm water and calls that gravy; or, when thick brown gravy is wanted, takes and washes out her not over-clean dripping-pan, mixes a little raw flour with it, burns some sugar in a spoon, and succeeds in spoiling sugar, spoon, and gravy by thrusting the ash-covered spoon into the mess; covering all its defects by large quantities of salt, half bottles of sauces, and relishes! No wonder people suffer from indigestion and dyspepsia! A good housewife and cook will always have for her gravies, 1st, *some Second Stock* (see Stock); 2nd, *Baked flour for thick brown gravies;* 3rd, *Boiled flour for white gravies and sauces;* and 4th, *Caramel to use when colouring is necessary* (see No. 106). Again I would impress upon the student that unless glaze is used, and glazing necessary, gravy should never be poured over a roast or baked joint, and a gravy of *salt and hot water never* sent to table.

222. *Gravy, thick brown.*—Take one pint of second stock, or liquor in which bones have been boiled, place it in a clean saucepan over the fire, add a tiny bit of mace, season with salt and a little pepper, let it come to the boil, mix in a basin one tablespoonful of flour which has been baked in the oven a deep rich brown (a store of this should always be kept for brown gravies by putting 1 lb. of flour on a flat tin in the oven, and baking it a *rich nut brown*, not black), pass it through a wire sieve and bottle for use; it gives the gravies a rich taste, and the flour is already cooked. With half a teacupful of cold stock, stir this into the boiling stock, stir till

it thickens, let it boil for one minute and serve. If the stock is very poor you may use a teaspoonful of sauce.

223. *Gravy, clear brown.*—Take some second stock sufficient for your dish or joint; put it into a saucepan with a small bunch of sweet herbs and a bay leaf; season it with salt, add one teaspoonful of sauce, and one or two drops of caramel if the colour is not deep enough; let it come to the boil, and strain ROUND the meat, *not over*.

224. *Gravy, white.*—Abroad the most exquisite white gravies or sauces are made for many of the *entrées*, and it is to the proper preparation of these I would specially in this example draw the attention of the student. For although *entrées* are not admissible in Artizan Cookery, yet where the materials cost little we may as well render the cottage home comfortable as not. To prepare the flour is the most important part of the whole secret; it is simply taking 1 lb. of flour, or more if you use large quantities, press it tightly into a basin, pressing it down with the bowl of the spoon. When the basin is quite full, flour a cloth and tie it tightly over the basin. Have on the fire or stove a saucepan with boiling water, place the basin with the flour in this, and let it boil *without ceasing* for six or eight hours. Take out the basin, remove the cloth whilst it is hot, and then put the flour on one side to get quite cold. When it is cold, remove any portion that may look like paste, and rub the flour through a wire sieve; bottle for use. For the *white gravy* take one tablespoonful of this boiled flour, put it into a basin and mix quite smoothly into a batter with a teacupful of cold stock; put into a clean saucepan over the fire another teacupful of nicely flavoured white stock. Pour in the flour mixture when the stock in the saucepan comes to the boil, let them boil together for three minutes, stirring all the time, and then serve with whatever meat you wish, with or without garnish. Melted butter made with boiled flour is richer to the taste and requires less butter than that made with the raw material.

225. *Gravy, clear white.*—Is made from veal, rabbit, chicken, or any white stock ; it requires no colouring, and the flavouring must be simply sweet vegetables. To render it quite clear requires the white and shell of an egg boiled up in it for three minutes and allowed to stand ; carefully skim off the froth, or strain through a clean napkin or glass-towel.

226. **Gruel,** *Scotch Oatmeal.*—Put on the fire $1\frac{1}{2}$ pints of water ; when it boils add about one tablespoonful of the coarse Scotch oatmeal by taking the *meal in the left hand*, and a wooden spoon (or stick) in the right. Stir rapidly with the spoon whilst you let the little grains of meal fall in a thin shower from your clenched left hand until it is all in ; then stir for a minute or so, and let it boil from twenty minutes to an hour. For serving, season with salt and butter, or sweeten with sugar, and add wine, nitre, or whatever the medical man orders. This gruel is aperient as well as healing.

227. *Gruel, English Oatmeal.*—The English meal as a rule is much adulterated with barley-flour, and if kept long becomes sour and bitter to the taste. It is well only to have small quantities at a time and to buy only from respectable corn-chandlers and dealers. Put $\frac{3}{4}$ of a pint of water in a saucepan on the fire to boil, take one dessertspoonful of the oatmeal flour, put it into a cup or basin, moisten it and render it like a smooth batter with a teacupful of cold water. Pour this into the boiling water over the fire, stir till it thickens ; let it boil ten minutes or a quarter-of-an-hour. Sweeten and flavour, or season with salt, as the patient may require.

228. **Gudgeon.**—Many little boys in the country catch quantities of these fish, and I have seen them thrown wastefully away where they might have made a wholesome supper or breakfast for the children, who, with once showing, could clean the fish themselves. Scrape off the scales, holding the fish by the tail, cut off the fins with an old pair of scissors, rip open the fish, clean, wash, and wipe dry. Dip each one in flour,

plunge it into boiling fat, and let it remain there till it becomes a golden brown. Sprinkle with salt and pepper, and serve hot.

229. **Haddock, to boil.**—If you have not a proper fish-kettle to permit the fish to be put in its whole length, boil it in an ordinary saucepan; fix the fish's tail in its mouth; after cleaning it thoroughly, tie it up in a *clean* cloth; place a plate in the bottom of the saucepan to prevent the cloth burning; put enough water in to well cover the fish, also a tablespoonful of salt, and one of vinegar; let the water come quite to the boil, then put in the fish; in about ten or fifteen minutes you may try if the fins pull out easily, and if so the fish is done; lift the pan on to the hob; let the fish rest in the water for a couple of minutes, then lift it out carefully on to a dish, untie the cloth, and serve either on a clean hot napkin, with lemon garnish, or make a melted butter and pour over.

230. *Haddock baked.*—Carefully clean the fish well, wash and wipe quite dry; now rub well into the inside a mixture of salt, pepper and flour; cut up a small onion, and mince some parsley and thyme, place *in* the fish; put it into a tin pie-dish with one teacupful of water, two tablespoonsful of vinegar, pepper, salt, one teaspoonful of moist sugar, and a bay or laurel-leaf. Bake in the oven for half-an-hour.

231. **Hake Cutlets.**—Cut a nice fresh hake into thick slices after it has been well cleaned, wipe each cutlet *quite dry*, flour it well all over; fry in plenty of boiling fat till quite brown. The great secret of having good fried-fish is to have the fat both plentiful and quite boiling. Fried parsley must be used as a garnish, and some good thick brown gravy with a table-spoonful of vinegar (see No. 222) makes a cheap and delicious *sauce piquante.*

232. *Hake (dried), boiled.*—Soak the fish at least twenty-four hours before you use it, unless you prefer it very salt. Choose thick white-looking fish, which has not the appearance of having been turned rancid by exposure to the sun. Change

the water at the end of twelve hours, scraping and cleaning the fish thoroughly; let it lie in the clear fresh water till you require to use it, then lift it out; dry it in a cloth. Have ready a saucepan with boiling water, to which add one tablespoonful of vinegar; place the fish in this, and boil from ten minutes to a quarter-of-an-hour. When thoroughly cooked lift it out, drain it, put a tiny piece of dripping or butter over, dust with pepper and serve hot, or with melted butter.

233. *Hake (dried), fried.*—Soak and dry the fish as in No. 232, and cut into neat pieces about three or four inches square. Prepare a batter as in No. 57, flour the pieces of fish separately, cover with the batter, and fry in boiling fat. When a bright brown, drain on paper.

234. *Hake Pie.*—Cut a fresh hake into cutlets, and subdivide each into two or three pieces according to its size. Put on a plate one tablespoonful of flour, one teaspoonful of salt, half-a-teaspoonful of pepper, mix well together; dip each piece of hake in the mixture, chop a small onion up very finely, strew it in the bottom of a pie-dish with 2 cloves and a little chopped thyme and parsley, place the pieces of hake in till the pie-dish is half full, then sprinkle more herbs; add 2 bay-leaves, and then pile the rest of the pieces up, keeping them well raised in the centre; add 1 teacupful of second stock, make a little short crust, cover the pie, and bake for one hour in a moderate oven.

235. **Halibut Steaks**—Are cheap and plentiful in the Northern and Midland counties, but they are often spoilt by bad cookery, and come to table tasting greasy and of burnt fat. They must be fresh, wiped dry, and dipped in flour; if it can be afforded to use an egg and some breadcrumbs as well as the flour, it is a great addition; if not, they can be made to look and taste very nice with only the flour. 1st, see that the fat is *thoroughly boiling*, that all the spluttering noise has ceased and is silent; 2nd, that there is enough to cover the steaks, and that it is sweet and fresh. When the steaks are a

nice brown, lift them carefully on to a paper to drain before placing on the dish; serve hot with good gravy or white sauce.

236. *Halibut Marinade.*—Melt a piece of dripping as large as an apple. Mix with it one tablespoonful of vinegar. Place the fish steaks on a flat plate, pour this mixture over, turn it every twenty minutes or half-an-hour, and let it stay on the plate in a warm place for an hour-and-a-half, then dust it carefully over with flour, chalk the bars of the gridiron, and broil the fish over a clear cinder fire.

237. **Ham Shank, to boil.**—Very often a profitable little shank or knuckle of ham may be bought from grocers' shops at a cheap rate, being the end of the ham, and not saleable as 'sliced ham.' If properly treated, three, or even four good dinners may be manufactured out of one of these, costing about 1s. 3d., or 1s. 8d. at the outside. Put the shank in soak for about twelve hours, *scrape and clean* it well, so that the water in which it is covered may be clean; then place it in a large pot with sufficient water to cover it; let it come slowly to the boil, skimming carefully. When it is done, carefully remove the outer rind, which is perfectly indigestible, grate a few bread crumbs from the top side of a well-browned loaf, serve with greens, or mashed turnips, but be sure that no vegetables are boiled with the ham, or it will taste of them, and spoil both ham and vegetables.

238. *Ham Rissoles.*—Mince ½ lb. of cold ham, season with pepper, &c.; mince ½ oz. onion, a little thyme, parsley, &c., also a tiny piece of lemon rind; mix with the meat. Now grate ¼ lb. of stale bread crumbs, add to the meat; also one egg. Mix thoroughly, flour a board, form into little balls, dip each ball into a little egg, cover thoroughly with it, and then toss the ball in bread crumbs. When they are all made up, have a quantity of fat at boiling point, test it with a piece of bread; if that browns quickly, the fat is ready; place the balls in a basket, and fry. Serve either on a napkin, or with some rich brown gravy.

239. *Ham Stew.*—Cut the meat in nice slices, dip them in a mixture of flour and pepper. Cut up an onion, one carrot, one turnip; put the meat and vegetables in a saucepan, with one pint of stock. Let it stew till the meat is tender, then thicken with baked brown flour; garnish it with toasted bread.

240. *Ham Bone Soup.*—Pound the bones with a large hammer until they are well broken up. Put them into a pot with three pints of cold water and one teaspoonful of salt. Whilst it is coming to the boil, skim well, and prepare the vegetables, viz.:—One carrot, one turnip, two onions; cut them into dice, and when the water in the pot fairly boils, add them, also a little pepper. Let it boil for four or five hours; thicken with either oatmeal (coarse Scotch is the most nutritious), or Symington's pea-flour, and boil till well-cooked—say half-an-hour to one hour.

241. **Heart Stewed à la Gothard.**—Lay the heart in salt and water, cut off the deaf ears, scrape a carrot, peel a turnip, and wash them, together with a leek (or a Portugal onion, if preferred). Chop them up, and place in the bottom of a stew-pan with one pint second stock and a few herbs. Prepare a stuffing in the proportion of 1 tablespoonful coarse Scotch oatmeal, put into a basin with 2 tablespoonsful of water, and leave to soak whilst 1 oz. of mutton suet is minced, and ½ oz. onion. Now mix with the oatmeal, season with pepper and salt, and put into the heart tubes. Lay the heart on the vegetables, and stew for 1½ hours. If the heart is larded it is a great improvement.

242. *Heart, to roast.*—Parboil the heart, putting it into boiling water, and letting it boil for one hour. Then have ready a nicely prepared veal stuffing; fill the heart tubes with this, put a greased paper round the heart, and have plenty of good dripping in the tin to baste the heart with. Keep it well basted for half-an-hour, then remove the paper and still keep the meat basted. Prepare a thick brown gravy, and put it

into a hot tureen. Ten minutes before dishing the heart dredge it over with flour. Dish every part of the dinner required to be served with the heart, and send it in before attempting to take it from the fire. Have the dishes and plates very hot, and serve on a dry hot dish.

243. *Heart cold, to hash.*—This may be prepared as in No. 244, but care must be taken to keep it well supplied with stock whilst cooking, and to serve very hot.

244. **Hash à la Gothard.**—After many trials to make a *tender, palatable* dish of hash, a dish which is so often spoiled, success at last crowned my efforts, and the following is the result. If the dinner is at one o'clock, this hash must be prepared, and in a slow oven, by nine a.m. Pare all the meat off the bones in finely-shred slices, being careful to cut the way of the grain. Put on a plate one tablespoonful of flour, one teaspoonful salt, $\frac{1}{4}$ ditto pepper, a *little* powdered mace, a *little* grated nutmeg (if liked); mix well. Take a *small* mushroom and one onion, shred finely, and strew in the bottom of the pie-dish; dip each piece of meat in the mixture on the plate, and lay in the pie-dish in even rows. When the pie-dish is half-full, put two bay-leaves, a few mixed herbs (dried and passed through a strainer), and three bruised cloves; fill the dish till three-parts full, then take one teaspoonful Worcester sauce, one pint of liquor from the stock-pot or stock jelly (on no account use water), stew 2 oz. bread crumbs passed through a wire sieve over the top, cover down with kitchen paper, and bake in slow oven four hours.

245. **Haricot Beans.**—Haricot beans may be soaked two hours before using, and a piece of soda put into the water greatly assists in the process of rendering them ready for boiling. After soaking, drain and pick the beans over carefully, removing withered or grub-eaten ones. Put them into a saucepan (say half-pint haricots for dish), with one dessert-spoonful of salt and cold water; let them boil at a moderate rate for about two hours, try them, and if tender, strain. Chop

about two tablespoonsful of parsley very fine, and wring it in the corner of a towel after mincing. Now put the beans back into the saucepan with 1 oz. of butter, the parsley and the juice of half-a-lemon, *sauté* them and put them into a hot dish and serve quickly.

246. *Haricot Bean Soup.*—Plain boil as in No. 245, drain and mash through a wire sieve, add to the pulp thus obtained one pint of good flavoured meat stock, and half-pint of milk; re-flavour with a little onion, season with pepper and salt, boil up, and serve with crutons of fried bread.

247. *Haricot Beans and Mince.*—Put the beans into a saucepan of cold water with a little piece of soda as large as a pea. The beans may be boiled at once without soaking, and if boiled rapidly for two and-half hours, are quite as tender as if soaked all night; strain and dress as in No. 69, and make them into a wall round a meat dish. Have ready some cold meat minced very finely and mixed with a teacupful of bread-crumbs, seasoned with pepper, salt, &c., enough stock to make it moist, and seasoned with dried herbs. Put this over the fire, stir it until it is hot, then pour in the centre of the wall of haricot beans. This makes a cheap, nutritious and tasty little dinner.

248. *Haricot Beans, Fried.*—Cold haricot beans left at dinner may be most deliciously served up next day by simply frying them in boiling fat, sprinkling them with salt, and serving on dripping toast.

249. **Herbs,** *to Grow and Dry.*—Nothing is more easy than to have plenty of herbs for kitchen use, even in the heart of London and large cities. Get a few herring or soap boxes, bore some holes through the bottom, put a layer of small stones in the bottom to act as a drain; fill the box with a mixture of silversand and soil. Place the boxes in the windows of the kitchens, where they can have light and heat. Sow the seeds of chervil, thyme, or whatever herbs you wish to grow, and you will always have plenty of nice fresh herbs with

little expense, and only the trouble of watering now and again. To dry herbs, gather on fine bright days in dry weather, and just before the period of flowering. Wash them, and if it is wished to retain a very green colour (in parsley, for instance), just plunge them into boiling soda water, and then place them on clean paper in a cool oven, leave the door open, and let them dry very gradually indeed. Pound, and sift the leaves; bottle and cork up for winter use.

250. *Herb Pie.*—Two tablespoonsful of parsley, thyme, mint, mustard and cress minced very finely, three leaves of borage, and a small heart of lettuce shred up. Place in a pie-dish, covered with well-seasoned stock; let them stew for twenty minutes in the oven, and prepare an ordinary light batter, well seasoned. Pour off the stock, pour in the batter, cover with a crust, and bake for three-quarters-of-an-hour.

251. **Herrings,** *how to choose.*—See that the flesh is firm, the eyes clear, the gills red. Never be persuaded to buy limp looking herrings, they are bad; and stale fish, like putrid meat, is highly poisonous.

252. *Herrings, Rolled.*—Clean, remove the head, and bone the herrings, mince one shalot, a little parsley and thyme, grate some breadcrumbs (or soak the hard crust of a loaf, and when it is quite soft wring it as dry as possible in a cloth), mix with herbs, salt, and pepper; place a little of this inside each herring, roll them up, fasten each with a small piece of white sewing-cotton wound round, dip each little roll in flour, place in a pie-dish with some good stock, a few cloves, pepper, salt, one lump of sugar, and two tablespoonsful of vinegar; bake one hour.

253. *Herrings, Fried.*—Wash and clean the herrings, wipe dry, dip in flour, fry in boiling fat till they are a good golden brown. They may be prepared as in No. 252, only, instead of baking, fry in plenty of fat after flouring. Drain on paper, pile on a dish, and send to table hot. The roes may be fried separately.

254. *Herrings, Baked.*—Clean the herrings, carefully remove the heads, flour each herring, place them head to tail in a greased pie-dish till it is quite full; then put a cupful of stock in the dish and some bread-crumbs piled over the top, with little bits of dripping here and there. Bake in the oven for one hour, and serve to table in the same dish.

255. *Herrings, Potted.*—Bone the herrings and put them into the oven to bake in a little stock; remove the outer skin, place them in a wooden bowl or basin, pound them well with a wooden potato-masher, season with pepper, salt, mace, nutmeg, &c., when they are about half-done. When quite reduced to a pulp pass through the wire sieve, press into little oval pots, and run a little dripping or butter over the top.

256. *Herrings, Home-cured.*—No. 1.—For quick consumption, clean, scale, and cut open each herring, wash and dry them; rub salt thoroughly into each one, then dust pepper over, take a little stick and fasten or skewer each one open, string them on a line or on a stick through the eye and hang in the open air, and use as they are wanted. They will keep two or three weeks. No. 2.—Procure a good strong tub, butter-firkin, or a large barrel, if you wish to pickle a large quantity. Clean the herrings; *but do not wash* them, lay them in regular rows in the barrel with layers of salt between, a layer of salt at the bottom of the barrel, and finish with salt at the top. They will keep as long as you like treated in this manner, and to cook simply require soaking in cold water a few hours before cooking. No. 3.—Make a brine of salt and saltpetre in the proportion of ½ oz. saltpetre to every 2 lbs. of salt used; this quantity is sufficient for 6 quarts of water. Put the water in a pan over the fire, let it boil five minutes, add 2 oz. of coarse moist sugar, skim carefully whilst boiling; when it is quite cold, pour over the herrings, which ought to be laid in regular rows in a pickling-tub or barrel kept purposely for fish. *On no account wash the fish;* they must be cleaned and wiped dry, and the heads taken off or left on at will. Let the herrings

lie in the brine twenty-four hours, then take them out and hang up to dry. If smoked herrings are liked, this can be done by taking a number of herrings on an iron rod or stout stick, fastening them to the inside bottom of a butter-tub or little barrel open at one end, and, with that exception, air-tight as possible. Light a little fire of oak-chips or any chips, so that you have oak sawdust to sprinkle on the top. When the fire has thoroughly kindled, place several handsful of oak-chips or sawdust on the top, invert the barrel over the fire, prop it up a little with a stone, so that there may be a draught of air, and let it remain in the smoke for two days; feeding the fire, of course, from time to time. This makes a nice change to the plain pickled herrings, and where herrings are cheap and plentiful the careful housewife cannot do better than provide for the home circle so wholesome and good a food in as many different ways as possible, especially in the present heavy price of meat.

257. **Horse-radish** *Armoraisia Rusticana.*—It much resembles *Aconite*, as the leaves are somewhat similar; but it may easily be distinguished, as the roots are larger, thicker, and have a strong pungent smell. The plant is found growing wild in the hedges and ditches, but it is only the cultivated roots which are used either as sauce, garnish, &c. The horse-radish contains a volatile oil, and all the most important principles of the plant depend on this oil being retained; therefore, in preparing it for table, it should be scraped or grated only a few minutes before it is used, as the oil quickly evaporates, and leaves the root useless. The qualities of horse-radish are dietetic, anti-scorbutic, stimulative, diuretic, anti-rheumatic, diaphoretic, and cosmetic; the latter when used in conjunction with milk and outwardly applied. Eaten by itself it has the same effect as mustard on the stomach, producing nausea. Eaten with meat assists digestion by exciting the action of the gastric juices, like mustard.

258. *Horse-radish Vinegar* is best made in the autumn, about

October. Wash the root quite clean, grate $\frac{1}{4}$ lb., mince two or three shalots, and put at once into a bottle; cover with one quart of good vinegar, *cork* and *seal*, shake for a minute or two every day or so, and at the end of eight days it will be ready for use, and form a capital relish for roast meat. A few drops (15) in half a cup of water makes an excellent gargle for sore throat and in the early stages of diphtheria.

259. **Hotch-Potch.**—The most noted hotch-potch in the world is that made at the George the Fourth Hotel, in Edinburgh. Epicures, statesmen, poor students, lawyers, men about town, ladies, all crowd thither in the sweet spring-time to taste this well-known dish at this well-known hotel. It was the fashion forty years ago, and the fashion has not worn out. The dish is made by carefully stewing a solid joint, say 2 lbs. of mutton or lamb neck chops (nicely trimmed), for about two or three hours. In another saucepan, in two quarts of good, well-flavoured stock, made from bones and parings of meat, are stewed, 4 oz. of young carrots, 2 oz. of turnips, $\frac{1}{2}$ oz. of onion, 2 oz. of young French beans; these stew till within a quarter-of-an-hour of the dish being required; then there is added seasoning of salt, pepper, &c., one head of blanched lettuce, shred fine, and the sprigs of a cauliflower. About one quart of peas are boiled in a separate saucepan. They are plunged into boiling water, with salt and soda, to make them an elegant green colour, and boiled for five minutes or less if the peas are quite fresh and very young. To each basin of hotch-potch is put one chop from the stewed mutton, one measure (half-pint) of the vegetable stew, half a measure of peas, and one tablespoonful of very finely-chopped parsley.

260. **Irish Moss** *(Chondrus Crispus)* is a sea-weed much used as an article of diet amongst the poorer inhabitants on the North and West coast of Ireland. It is also used medicinally in this country in cases of chest disease. It is known also as carraigeen, and was what may be termed a 'fashionable

remedy' some thirty years ago for consumption. It is still used, however, and contains very valuable properties.

261. *Irish Moss Blanc Mange.*—Take 1 oz. of the moss, soak it in cold water over night; rinse it well; put it into a saucepan with 1½ pints of new milk. Stir it frequently, and leave it simmering near the fire for two hours; sweeten, and strain into a mould.

262. **Iceland Moss.**—People are very apt to confound these two mosses (Irish and Iceland), as both are used in cases of consumption; but the *Iceland Moss (Cetraria Islandica)* is quite distinct in taste to the Irish moss. In fact, the former is a lichen. Its taste is almost identical with reindeer's milk, having a sort of wild bitterness. In Russia and Lapland a strong spirit is made from it. In Iceland it is ground up and used somewhat like flour. It is rich in saccharine matter, and carbonaceous food. It is this quality for which it is used for delicate people. It has also tonic properties.

263. *Iceland Moss Jelly.*—Take 1 oz. of Iceland moss, put it into an earthenware pan or basin with 1 gallon of cold water, in which is dissolved ½ oz. carbonate of soda. Let it remain in this solution for two or more hours, to remove the bitterness. Wash it well in clear cold water twice. Next place it in a stewpan with 1 quart of cold water; let it stew slowly for three hours, keeping the moss covered; strain and sweeten. Pour into a pint mould. The liquor should reduce to 1 pint in the process of cooking.

264. **Isinglass.**—I would say a word about isinglass. If you cannot afford to purchase the pure isinglass, which runs from 15s. to 18s. per oz., Nelson's loose gelatine will answer the purpose quite as well, for most of the isinglass is simply a very pure gelatine, most frequently never made from fish gelatine at all. The best gelatine is supposed to be made from the swimming bladder and sounds of the sturgeon; the second quality from fish bones, such as plaice, skate, soles, &c., after the fishmonger has filleted them.

265. *Isinglass Jelly (savoury).*—Take ½ oz. pure isinglass; put it into a saucepan with one quart of water, six peppercorns, six cloves, quarter salt-spoonful of salt, and a crust of bread from the top side of the loaf; stir till the isinglass is melted; let the water simmer away to about one pint or rather less; beat up the crust well so as to be equally mixed with the jelly; dip a mould into water; lift the saucepan with the jelly off the fire, pick out the cloves and peppercorns, pour in a small glass of port or sherry, mix and pour the whole into the mould. If stood in ice, this will be found an excellent sick-room food where it is necessary to feed and give cooling jellies to the patient. If isinglass cannot be had, Nelson's gelatine (loose), will answer the purpose, using ¾ instead ½ oz.

266. **Jams.**—General directions for making jam will be sufficient to guide the student. For instance, rhubarb, blackberries, and all fruits of a like wet nature, require to be boiled for an hour, or even *two hours* if it is a wet season, skimming well before adding the sugar, or the jam will not keep; this is to evaporate the water, or over-supply of moisture. Weigh the fruit previous to boiling, and then add, after it has boiled a sufficiently long time, in the proportion of 5 lbs. of sugar to every 7 lbs. of fruit; boil for three-quarters of an hour to an hour. All jams that are wished to keep are best boiled first and well skimmed before adding the sugar.

267 **Jelly, Cow's Heel.**—See No. 108.

268. **Jellies, Fruit,** are nearly all similar in their method of manufacture. The fruits, whether they be currants, bilberries, gooseberries, blackberries, &c., all require first boiling and stirring, with one quart of water added to the 7 lbs. or gallon of fruit. This must boil from three-quarters of an hour to an hour over a clear fire, being well and carefully skimmed the whole time. Then strain through a clean cloth, being careful not to press the fruit so as to render the juice muddy or thick; then clean out the preserving pan, return the juice to it

with 1 lb. of loaf sugar for every pint of liquid, skim well and let it boil rapidly for half-an-hour. Put into *dry* jars or moulds, and when cold tie down securely with brown paper.

269. *Jelly Rusk.*—This is a most useful jelly for the sick-room, and may be iced in summer. Take three rusks (cost 1d.), roll them into crumbs, place them in a sauce-pan with one quart of water, two or three pieces of lemon-peel, and a little sugar, let the whole boil, stirring frequently, until it is quite a stiff jelly; pour into a basin. The basin may be set in ice, and a spoonful of this administered alternately with other food. N.B.—It is not well to make food for the sick-room too sweet, rather let the patient ask for more sugar than give them a loathing for their food by supplying too much.

270. *Jelly, strengthening.*—One ounce sago (crushed), 1 oz. rice, 1 oz. best pearl barley, wash well in a sieve or strainer, and put into a saucepan with three pints of cold water. Stand the saucepan on the oven for one hour, so that just a gradua heat may come to the grains in it; then move it on to the fire and let it come to the boil stirring the while. Now let it simmer for another hour, strain through a hair sieve, add a tea spoonful of strong essence of beef or a glass of port as may be ordered by the medical man in attendance, and other seasonings as the case may permit. This jelly may be sweetened with sugar and eaten with milk.

271. **Ketchup, Walnut.**—Take 2 lbs. of the green shells of the walnuts (costs 1d.), put them into an earthen pan with 2 lbs. of salt; stir them frequently the first day; the second, take a wooden potato-masher, beat them well; the next day repeat the operation till they are quite like a pulp. Now drain off the liquor by pressing through a coarse towel; be careful not to squeeze the shells with your hands or they will be very much stained for some days; the shells may be returned to the pan; well beaten, another handful of salt sprinkled over and left till next day, then strained, the juice added to the rest. If the shells are fairly young and fresh

gathered, there will be about three or four quarts of liquor; put this into a saucepan with ½ oz. cloves, ½ oz. long pepper, 2 oz. ginger, 1 oz. whole pepper, 1 oz. mustard seeds, all well bruised, and three shalots. Boil for two-and-a-half-hours very slowly, strain and bottle. Cork and seal the bottles; it will be ready for use at once and will keep for years; used for flavouring stews, hashes, steaks, &c.

272. **Knuckle of Mutton, Stewed.**—A knuckle of mutton can often be made into a tasty little dinner, whilst it contains a good deal of bone and may be bought cheap. Plunge the knuckle into a saucepan, having sufficient boiling water to cover it; let it boil fast for five minutes, then pull it back from the fire and let it simmer for about four hours. As soon as the knuckle has boiled the five minutes, add the following vegetables, cleaned and cut into *small dice*, and let them stew for the four hours with the mutton:—1 oz. of carrot, 1 oz. turnip, ¼ oz. onion, ½ oz. celery or a dozen celery seeds, six cloves, six peppercorns, one teaspoonful of salt; now place 1 oz. of sago in half pint of cold water and let it soak. When the meat has stewed for the required length of time, lift it out and keep hot, pass the gravy through a sieve, passing the vegetables also through; return it to the saucepan, let it come to the boil, stir in the sago, boil for five minutes, stirring the whole time; flavour with sauce, season, and pour round the knuckle.

273. **Liver Balls.**—The German peasants make some of the nicest dishes possible out of liver; a few may be useful, and only require to be tasted to be thoroughly appreciated. *Liver Balls* are made by mincing finely 2 oz. of boiled liver. The water in which the liver is boiled is just sufficient to cover it, and, instead of being given to the pigs or thrown out in front of the house, is used for gravy. After mincing the liver, 2 oz. of breadcrumbs are taken (or even stale crusts soaked, in lieu) and mixed with about one teaspoonful of finely chopped herbs, and an onion also minced. This is all seasoned with

pepper and salt, bound together with an egg, formed into balls or flat cakes, egged over and fried in plenty of boiling fat. A thick gravy is made with the liquor and served round the balls.

274. *Liver Pie.*—Prepare a seasoning of an onion, parsley, and thyme, well minced. Soak any stale crusts in cold water and wring them dry; mince 2 oz. of fat bacon. Mix all this well together. Mix on a plate one tablespoonful of flour, one teaspoonful of salt, half teaspoonful of pepper; cut the liver into thin slices and dip each piece in seasoned flour. Put a layer of liver in the bottom of the pie-dish, then a layer of the seasoning, and so on alternate layers until the dish is full. Let the last layer be liver, and pile it well up in the centre of the dish; put half-pint of stock for gravy, cover with a short crust, brush over with milk, and bake in an ordinary oven one-and-a-half-hours.

275. *Liver, stewed.*—Cut the liver into thick pieces, about three inches long and two thick. Mince some thyme, parsley, and an onion. Cut some thin slices of fat bacon. Dip each piece of liver in flour, lay it on a strip of bacon, sprinkle a few of the herbs on the liver, roll it tightly up in the bacon, dip it again in flour, and lay on a plate till all the other pieces are similarly rolled. Now in the bottom of the saucepan or stew-pan place some rings of carrot, turnip, onion, &c.; place the rolls of meat on this. Add sufficient stock, seasoned with salt and pepper, to cover the rolls, put on the lid, and let the whole *simmer, not boil*, for one hour. Lift the rolls out carefully on to a hot dish, pass the gravy through a wire sieve, heat in the pan for a minute, and pour round the meat.

276. *Liver Mince and Potato.*—Mince 1 lb. of bullock's liver, also ½ lb. mutton suet; put into a basin with half pint of cold water and beat up with a fork, season with pepper and salt. Put the whole into a saucepan over the fire, beat with the fork until it is quite hot and all separated into little grains, draw the pan to the side of the fire and let it simmer for twenty minutes; peel, boil, and mash 1½ or 2 lb. of potatoes, make

them into a wall round a meat dish, put it in front of the fire to brown. Mince 1 teaspoonful of parsley, and five minutes before serving stir it into the mince, pour the mince into the centre of the potato-wall, and serve hot.

277. *Liver, stuffed.*—Choose a calf's or sheep's liver. Lard it carefully with little pieces of fat bacon. Prepare a stuffing of bread crumbs, thyme, parsley, a little piece of lemon-rind, 2 oz. suet; mix with a little milk. Grease a small baking-tin, spread the stuffing in the tin, lay the liver over, and bake for three-quarters of an hour.

278. **Lemon Garnish for Fish.**—Cut in thin slices, halved, and then almost quartered, and half a pickled walnut laid between the two quarters. Plain boiled fish should always be sent to table on a clean hot napkin.

279. **Lemon Syrup.**—One lb. lump sugar moistened with the juice of three lemons, and the grated rind added; one quart of water, bring to the boil, stirring with a wooden spoon all the time. Boil up twice, strain, cool a little, and bottle. Dose one teaspoonful to one gill of water.

280. *Lemon Paste for Cheese Cakes.*—Put 1 lb. of butter and 1 lb. of sugar into a clean saucepan, stir till the sugar is melted; add the juice of 2 lemons; put the yolks of 8 eggs, and the whites of four, into a basin, blend well, add the grated rind of 2 lemons; now stir this into the mixture in the pan, let it boil gently (stirring the while) till it looks like honey; pour into a dry pot when cool, cover as you would jam, and it will keep for twelve months or more in a cool dry place. N.B.—This paste is equally good without the butter, and will keep longer sweet.

281. **Luncheon Cakes.**—Put into the oven and dry 1 lb. of flour, when it has been in about ten minutes take it out and pass it through a wire sieve into a clean basin; add 1 teaspoonful of baking powder, 4 lbs. of ground rice (it can be bought at 2d. per lb. and ground in the coffee mill), also $\frac{1}{4}$ lb.

Johnson's corn-flour; with a clean wooden spoon beat 4 oz. of dripping to a cream, drop in ½ teaspoonful essence of lemon, and add by degrees ¼ lb. moist sugar; either add Caraway seed at this point, if wished; now add the flour mixture by degrees till the whole is mixed thoroughly with the sugar and dripping. It will require very little more moisture, and that may be added in the shape of an egg, milk (sweet or buttermilk) or water. It is impossible to say the exact quantity, as flour differs so much, some qualities absorbing and requiring more liquid to moisten them than others. Beat the mixture up well with the spoon, grease a tin, tie a band of clean greased paper outside the tin, and reaching three inches *above* the top rim; pour in enough cake mixture to three parts fill the tin, bake for one-and-a-half hours in a moderate oven; when it is done (test by a bright skewer) lift it carefully out of the tin and place it on the wire sieve till cool.

282. **Macaroni.**—There are two kinds of macaroni, the expensive white coiled, and the Neapolitan, which is brown and in long sticks; the price is about 4d. per lb. This cheap brown macaroni is the true unadulterated macaroni, but the white is simply an imitation made in England from potato-starch and other ingredients to suit the English taste.

283. *Macaroni, to dress.*—Wash the sticks, say ¼ lb. for one person's dinner, break them up into short lengths and put them to soak in a half-pint of milk or water for one hour, then boil till it has absorbed the milk, stirring so that it may not adhere to the bottom of the pan. (1). If SAVOURY macaroni is required, grate 2 oz. of strong cheese, season with a little pepper, add a bit of butter as large as a hazel nut, stir this in amongst the macaroni; have a little more grated cheese ready, dish up on a hot plate and serve at once with the grated cheese over. If it is preferred, put it into the oven or before the fire and brown the top; it makes a change the browning of it, but abroad the peasantry mostly cook it as above, and eat it without putting it in the oven or browning. (2). For puddings,

prepare as far as No. 1, and then take one egg, blend it, add one tea-cupful of milk, mix, sweeten to taste, flavour with a laurel-leaf or lemon-rind, &c., at pleasure; mix in the cold custard, strew some bread crumbs over the top and bake half-an-hour to one hour according to the capability of your oven.

284. **Marrow (vegetable) Squash or Pie** (American recipe).—Choose a nice fresh pumpkin or vegetable marrow, peel, and boil about 1 lb. weight of it until it is quite soft and tender. Pass it through a wire sieve into a clean basin, having first removed the seeds. Mix with one gill of cold milk, beat it up well. Next add 2 oz. sugar, ½ oz. butter, lemon essence, or the rind and juice of a lemon. Line a pie-dish with paste, pour in the squash mixture, and bake in a slow oven one hour.

285. *Marrow* (*vegetable*), *stuffed*.—Choose a small pumpkin or vegetable marrow, peel it and hollow out the seeds with a sharp knife, mince up two tablespoonsful of cold meat, season with pepper, salt a chopped onion, and mix with bread crumbs sufficient to fill the marrow, stuff it, put the lid on the end, tie in a floured cloth, boil till tender, and in the meantime prepare some melted butter and parsley, dish up the marrow, pour the sauce over, and serve at once.

286. **Mutton, Leg of, to Roast.**—Place the leg on the table; examine it to see there are no flyblows or tainted portions; wipe it carefully; with a sharp knife cut the sinews near the knucklebone, bend it round, to give the joint a plump and elegant appearance. Put in the dripping pan ½ lb. good dripping, and when it has melted, hang the leg with the knuckle end *on* the hook, and pour some of the hot dripping over the joint. Now move it CLOSE TO THE FIRE for the first FIVE minutes, so as to let the heat contract the outer cuticle and preserve the osmazone. After that time, draw it away about ten or twelve inches (according to the strength of the fire), and let it roast a quarter of an hour for every lb., and a quarter of an hour over if the joint is under 10 lbs. It must be well and

frequently basted—much of the goodness of the meat will be lost if this is not attended to.

287. *Leg of Mutton, to boil.*—Cut the joint as for roasting, bending the knuckle round. Tie it up in a clean cloth, which has been well rinsed in cold water, to insure the absence of soap suds and soda, and dried again. Put an old plate at the bottom of the saucepan or pot to prevent the cloth burning, if you have not a perforated tray. Put into the water half a lemon or one table-spoonful of vinegar, if you think the fibre of the meat is likely to be tough. As soon as it boils, put in the meat, finish as directed above; when it is sufficiently cooked lift it out, and put on a clean hot dish, and have ready a little clear well-flavoured strong stock; pour round and garnish with turnips, boiled and mashed, the water thoroughly expressed, and the turnips seasoned. A little bit of butter added, and the whole warmed up in a saucepan, fill a buttered cup with the turnip; turn the little mould thus formed out on the dish, making similar moulds until the dish is properly decorated; a little speck of finely chopped parsley laid on the top of each little shape, which is round the meat, makes a neat finish.

288. *Breast of Mutton à la Gothard.*—Take a breast of mutton; remove the outer skin from the fat, or score it as you would a leg of pork with a sharp knife; turn it over and bone it by taking a knife and cutting the membrane which covers the bone, pass the knife down the back of the bone and slip the bone out. Now trim the breast; put the pieces of fat aside for rendering down, and put the bones into the stock-pot. Take four dried sage leaves, crumble them through a fine strainer. Take 2 oz. onion, peel, and chop into small pieces; put them into a basin with a teaspoonful of salt, pour boiling water upon them, and let them stay in the water five minutes. Whilst the strong flavour is being extracted from the onions pass 3 oz. of bread crumbs through a wire sieve; mix with the sage; add pepper, salt, and nutmeg to taste. Now strain off

the water from the onions, wash them in cold water, strain and mix with the rest of the stuffing. Spread this mixture evenly over the inside of the breast, then take the narrow end in your hand, roll it tightly up, secure it with twine and skewers, and roast for one hour.

289. *Shoulder of Mutton à la Gothard.*—This is a dish fit for an epicure, and yet it is so wholesome, nourishing and economical, that it is very suitable to a family where there are growing children. Put into a basin $\frac{1}{2}$ lb. coarse Scotch oatmeal, 1 teaspoonful of salt, $\frac{1}{2}$ teaspoonful of pepper, mix well, and pour over it $\frac{1}{4}$ of a pint (= 1 teacupful) of water. Whilst the oatmeal is absorbing the water, put the hastener to the fire, and see that all is in good order for roasting. Shred an onion *very* finely and chop it; also 2 tablespoonsful of mutton suet; mix these with the oatmeal in the basin. Take the shoulder of mutton, examine it to see that it is quite fit for cooking, turn it with the outer skin next the table; raise a flap of meat which you will find on the inside, pass the knife down between the silk-like membrane or skin, and, having loosened it, commence to stuff the joint. When the aperture is filled (do not put too much in as the oatmeal will swell), hang it on the jack the *reverse* way to a leg of mutton, viz., with the knuckle downwards and the hook through the thin end of the blade. Now form the rest of the stuffing into little balls. It is very nice if an egg is mixed with it before making-up into the balls. Put $\frac{1}{2}$ oz. of dripping into a little dripping-tin, place the balls in the tin and put it into the oven to bake; about $\frac{1}{4}$ of an hour (or more, according to the heat of the oven) before the joint is done. Serve on a separate dish from the joint.

290. **Norfolk Dumplings.**—Put into a basin $\frac{1}{4}$ lb. flour, one teaspoonful of salt, and one teaspoonful of baking powder. Mix with *tepid* water into a dough, flour a board, form into little balls, and put into a pot with *boiling* water, put the lid on and let the dumplings boil for twenty minutes without lifting

the pot-lid. Serve at once on taking out of the boiling water. Do not cut, but tear them open with two forks, and they will be deliciously light.

291. **Oatmeal Porridge.**—One pint of *boiling* water, a little salt. Take a wooden spoon in the right hand, and a handful of coarse Scoth oatmeal in the left; commence stirring the water with the spoon, and drop the grains of meal slowly from the left hand until it is emptied. Let the porridge boil slowly for half-an-hour at least, but an hour will greatly improve it. Eat with milk. Porridge is overheating to the system when eaten with sugar or treacle, and is quite spoilt as an article of diet.

292. **Ox Cheek.**—Take three or four pounds of ox-cheek, wash it, and lay it out on a board. Prepare a stuffing, as for a heart, of breadcrumbs, suet, thyme, parsley, pepper, salt, &c. Roll the meat tightly up, bind with tape or tie with twine, and put it into a stew-pan with one pint of water, a turnip, carrot, &c., then stew for three or four hours; strain the gravy and thicken. Serve in a tureen hot round the ox-cheek. Haricot beans and ox-cheek are delicious, the former making a pretty garnish to the dish.

293. **Potato Croquets.**—Boil 3 or 4 potatoes, mash them through a wire sieve with a wooden spoon, add 1 oz. of butter, the yolk of an egg, season with pepper and salt, whip the white of the egg to a stiff froth, and stir half of it in. Now form into balls, dip into an egg beaten up, roll in breadcrumbs. Have ready a pan of fat at boiling point, put the little balls into a frying-basket, so that they only just touch each other, plunge them into the fat, and let them stay until a golden brown colour (chopped chicken added to the potato makes croquets of chicken), and drain on kitchen paper and serve hot.

294. **Poor Man's Plum Pudding.**—¼ lb. currants washed and picked, ¼ lb. raisins stoned and picked, ¼ lb. sugar (moist),

$\frac{1}{4}$ lb. mutton suet, minced. Put into a basin with $\frac{1}{2}$ lb. of breadcrumbs and $\frac{1}{2}$ lb. flour, 1 potato peeled and grated (this is superior to egg for binding), 1 carrot also grated, after being washed and scraped, and a $\frac{1}{2}$d. packet of mixed spices. Mix all well together with a sufficient quantity of milk to make the pudding of a proper consistency. Put this into a quart basin, cover down, and boil four hours.

295. **Pork**.—Pork will require to be WELL cooked if it is used at all as an article of diet; but it is the author of so much sickness, that, *if such a thing were possible, it ought to be banished from every well-regulated household.* We have only to read the articles in the medical journals to find the harm it is working amongst pork-eaters.

296. *Pork, Loin of, to Roast.*—Prepare the following stuffing:—2 oz. bread-crumbs, 1 oz. of boiled onions, $\frac{1}{2}$ a teaspoonful of chopped lemon-rind, and 1 teaspoonful powdered sage leaves (fresh minced). Mix well together; season highly with pepper and salt. Take the pork, and with a sharp knife score the rind in narrow, even, regular lines. Make an incision between the kidney fat of the pork, and fill with stuffing. Roast in the usual way, previously pouring some melted dripping over the scored skin, and giving half-an-hour longer than other joints to ensure the meat being thoroughly cooked, and rendered as digestible as pork can ever be made. Gravy as in No. 3. Roast pork is usually eaten with apple sauce (No. 3). In Yorkshire it is eaten with boiled apple pudding or baked apple dumplings, either of which forms a most agreeable accompaniment, besides being very economical, and especially suited for children, whom it is not wise to over-feed with meat, especially pork.

297. *Pork Pie Crust.*—8 lbs. of flour, 2 lbs. of lard, $\frac{1}{2}$ lb. of butter. Put the lard and butter into 3 pints of water, when it boils let it simmer for five minutes, then stir it into the flour with a *knife.* You will not require all the liquor, half a pint or

more will be left to make your crust of proper stiffness. It requires a very great amount of working; these quantities are enough for *six* good-sized pies.

298. **Pudding, Yorkshire,** is the usual accompaniment to baked beef. Take 3 tablespoonsful of flour, 1 pint of milk, 2 eggs; drop the eggs into the basin with the flour; mix a little, add the milk by degrees, beating the pudding up well, for on the light and thorough beating depends the success of the pudding. Grease the baking-tin, put about two tablespoonsful of dripping from the meat into the tin, and put it into the oven to get thoroughly hot, then pour in the batter mixture. It will be ready in about a quarter of an hour.

299. **Rissoles of Cold Meat.**—Make a short crust, cut into circles with a fluted cutter, mince and season with pepper and salt and chopped onion any cold meat there may be at hand; mix a few breadcrumbs with it, and place a little of the mixture in the centre of each circle; moisten the edges, fold the paste over the meat, brush with egg, and dip in breadcrumbs. Fry a golden brown in boiling fat, drain on kitchen paper, and send on a hot napkin to table.

300. **Stewed Rabbit.**—Cut up the rabbit, after it has been properly cleaned, into nice joints; wipe them, dredge them over with flour, and fry in boiling dripping; place each joint, when it is nicely browned, on kitchen paper, so that any dripping may be absorbed; take a slice of turnip, fry it, also 3 or 4 slices of onion, and a carrot; when all the vegetables are nicely browned, drain them on the paper. Take a clean stewpan, put in the fried vegetables, a slice of lean ham, and then the rabbit, cover it well with stock, add 3 cloves, a bunch of sweet herbs, a small portion of lemon-rind, 6 whole peppers, and salt to taste. Let it stew slowly by the side of the fire, with the lid on, for four hours; if the stock evaporate, add more. Place the rabbit on a hot dish, pass the gravy, and rub the vegetables through a hair sieve; if it is too thick, add a

little more stock; pour this round the pieces of rabbit; *garnish* with crutons or toasted bread. The former are more elegant. Cut the bread into half moons (crescents) with a round, fluted cutter, fry them in the dripping before you fry the meat, and put them on one side till you begin to dish up. A properly stewed rabbit, and properly stewed meat, requires no artificial colouring or flavour from sauces.

301. **Soup, Vegetable.**—Take $\frac{1}{4}$ lb. potatoes, peel and slice them; scrape $\frac{1}{4}$ lb. carrots, 1 oz. of turnip, slice these, also 1 oz. of onion. Put all into a large saucepan, with 3 quarts of water. Boil for $1\frac{1}{2}$ hours, and then pass through a wire sieve; season with pepper and salt; add a teaspoonful of Yorkshire relish. Boil for ten minutes, and serve with toasted bread.

302. *Soup, bone.*—Get from the butcher's 2d. worth of bones; pound them with a large hammer until they are well broken up. Put them into a pot with 3 pints of cold water and 1 teaspoonful of salt. Whilst it is coming to the boil, skim well, and prepare the vegetables, viz.:—1 carrot, 1 turnip, 2 onions; cut them into dice, and when the water in the pot fairly boils, add them, also a little pepper. Let it boil for four or five hours; strain and thicken with either rice or oatmeal. The latter (coarse Scotch) is the most nutritious.

303. *Soup, Potato.*—Peel and chop about 3 oz. of onion, peel 1 lb. of potatoes, slice them, put them (the potatoes) into a saucepan, with a tablespoonful of salt, and let them come to the boil, and then pour away all the water. Take 1 quart of stock, put it into a clean saucepan, with the onions and potatoes, add pepper and salt, stir frequently and let it boil about half an hour; pass through a wire sieve into a clean basin, and put into the saucepan again to keep warm on the hob till the moment it is required for dinner; pour into a hot tureen and serve.

304. **To Broil a Steak.**—Take a steak which has been cut and hung up two or three days—if it is summer weather, and it has been brushed over with acetic acid to keep off the flies,

wash it in warm water—wipe it dry, put it into a soup plate or dish, and cover it with salad oil. Let it remain in this about twenty minutes (or longer), then sprinkle a little pepper over, and broil as above directed, heating the gridiron, &c. A broiled steak requires no gravy; if properly managed it will be full of delicious gravy, which will pour out as it is cut. When dishing sprinkle a tiny quantity of salt over the meat, serve at once on a hot plate, and have ready fried potatoes, dressed thus—peel the potatoes, cut them into small strips, or rings, or like new potatoes, but of an uniform size and thickness; put them on in a pan with cold water and plenty of salt, let them just come to the boil, pour off the water, separate them out on a sieve to dry. Just before dishing the steak, have on the fire a frying-kettle, with boiling fat; put the potatoes in a wire frying-basket, plunge them into the boiling fat, let them become a golden brown (not too deep a colour), throw them on kitchen-paper, sprinkle with salt and place round the edge of the dish with steak in centre.

305. **Trifle à la Johnston.**—Prepare a blanc-mange as follows:—Two ounces of Johnston's corn flour, and 1 quart of milk, well mixed; *boil for ten minutes*, and flavour to taste. Pour it whilst hot into a glass dish, spread four tablespoonsful of jam to the quart of blanc-mange over the top; soak in a glass of wine two penny queen or sponge cakes spread over jam; whip the whites of two eggs to a stiff froth, stir in a dessert spoonful of finely crushed lump sugar, spread this over the contents of the glass dish, and just before serving to table sprinkle with $\frac{1}{2}$ oz. of hundreds and thousands (small comfits).

306. **Wines,** *home-made.*—These are simple enough, and no cottager need be without his home-made wines if he wish it. Bilberries, blackberries, elderberries, &c., cost nothing but the gathering, and sugar is not expensive. The proportions are 3 lbs. of sugar to every gallon of liquor. The fruit must be gathered in dry weather, and it ought to be ripe. Put it into

a tub, and with a wooden potato-masher bruise the fruit well. Then quite cover with boiling water, throw a cloth over the tub, and let it stand for three weeks. Strain it through a flannel bag. Mix the liquor with sugar and put into the cask, leaving the bung out; let it work about ten days, filling up the cask with a little of the liquor, which must be kept back on purpose. When it has done working bung it down, first putting in $\frac{1}{2}$ oz. of isinglass and $\frac{1}{4}$ lb. raisins. In six months it may be bottled, and is ready for use.

Section V.

CLOTHING AND LAUNDRY WORK

By MISS MANN.

Lecturer at the Training School, Liverpool.

CLOTHING:

ITS USES AND SELECTION.

By Miss Mann, Lecturer at the Training School of Cookery and Domestic Economy, Liverpool.

The principal use of clothing is to keep the body at the right temperature, by protecting it from excessive heat or cold. This right temperature is 98° Fahr., and as the outside air in England and all temperate climates is usually many degrees less than that, it follows that the body must both be protected from cold and provided with a means of retaining its own heat.

The natural heat of the body is provided by the heat-giving or carbonaceous food uniting with the oxygen which is taken into the body by the lungs during the process of breathing. When carbon and oxygen unite they cause a burning, and while this burning proceeds the whole of the surrounding parts are kept warm. When the supply of carbon or oxygen fails, the warmth ceases and the result is death.

Now clothing does not aid the oxygen and carbon in **making** heat, and it is therefore a mistake to speak of it as warm or cool. It however helps to **retain** it; and when the atmosphere is below the normal heat of the body or 98°, the clothing should be of a non-conducting material, *i.e.*, a substance that does not readily allow heat or cold to pass through and escape. It is important to keep in the natural heat, and equally important to keep out the cold air, and non-conducting materials will fulfil both conditions. Of these, felt is perhaps the most perfect, but fur, wool, feathers, and down have also this property in a very large degree.

When the atmosphere is above 98° clothing is necessary to

protect the body from it, and to carry off some of the natural heat generated by the union of oxygen and carbon. A good conductor is then required, and this is found principally in linen, cotton, and silk.

The first and most important point in the selection of clothing is its healthfulness, both of material and fashion. Remembering that its principal use is to maintain the temperature of the body, the clothing, especially that which is brought into direct contact with the skin, should be not only non-conducting but of an absorbent nature. The surface of the skin is covered with small mouths or pores—only to be discerned under a powerful microscope—the function of which is to carry off the perspiration of the body. This perspiration is of the same heat as the body, and contains carbonic acid gas, one of the poisonous waste products, and an especially rich and favourite soil for fever germs and all disease. It is also largely composed of oily matter, and these, if left on the skin through the inability of the clothes to remove them, are re-absorbed and close the pores, preventing the free passage of the perspiration which is so essential to health. This oily matter when it leaves the pores becomes quickly chilled, and if not at once removed from the skin produces a cold uncomfortable feeling, probably resulting in actual 'taking cold.'

The average amount of perspiration of a man per day is two pints, and if his occupation is laborious or heating, much more. An idea may thus be gained of the intense discomfort, apart from the actual danger, of so much unhealthy moisture about the body, and the importance of wearing such clothing as will remove it and prevent ill effects.

The best non-conductor and absorbent combined which can be brought into contact with the skin is flannel or wool, and this should form the inner garment of all, whether actively employed or not, and especially should the vital organs be protected by this material. These organs are—the heart and lungs, which fill the cavity of the thorax or chest; the

stomach and liver, which lie in the middle of the body; and the kidneys, which are at the back of and below the waist.

Flannel is regarded by many as too hot for summer wear, but this is a mistake, for though it is a non-conductor of heat, it is also a perfect absorbent, and by removing the perspiration keeps the surface of the skin dry and cool. Also it is made of so many qualities and weights that it may be had very little thicker than ordinary cotton or linen.

Healthfulness however depends on more than the mere material, for however suitable that may be, if the fashioning of the garment is not according to certain rules, as much injury is done in another way as by wearing improper substances.

The custom in men's dress of wearing the throat and chest partly or entirely uncovered by the outer garment, is a very bad one. Although it may be protected by flannel and linen also, still the vest and coat frequently are not closed to the throat, and so two of the most delicate and vital parts of the body—the lungs and heart—are less carefully covered than the back and limbs, which are much more capable of bearing the exposure.

Then in small children of both sexes the legs are much too frequently left uncovered, laying the foundation of rheumatism, which more frequently attacks the feet and legs than almost any other part.

In girls' and women's dress still greater evils are to be discovered. Several of the most delicate organs are round or near the waist, and pressure brought to bear on these, through the habit of fastening the principal and heaviest part of the clothing round the waist by bands, is a fruitful source of pain and disease. Women's garments, as much as men's, should be made to depend from the shoulder, which is formed by nature to bear their weight. Pressure on any portion of the frame is to be strongly deprecated, for not only does it entail pain and discomfort until 'habit becomes second nature,' but it invariably means considerable loss of energy and power both

of work and endurance, and in numberless cases results in actual disease and deformity.

All clothing should be so fitted and adjusted to the body that the free action of both muscles and limbs is not in any way interfered with, and it is a great mistake to suppose that weight will add to warmth. In one way it certainly does so, because the labour of carrying heavy clothing, even when properly adjusted on the shoulders, quickens the circulation for the time being, but will be followed by fatigue and exhaustion, which are always accompanied with a feeling of chilliness.

Warmth, comfort, and lightness are points to be aimed at in choosing all clothing and more especially those portions which are called under-garments. If the underwear is badly chosen or fitted, no care expended on the over-garments will compensate for the loss of ease and comfort, or give the freedom and grace of movement which is so essential to an able carrying on of work, and the presenting of a pleasant appearance. Of all animals, Man is the only one that has to provide his own clothing. The lower animal creation is provided with a natural covering, in all cases perfectly and beautifully adapted to its wants and its natural condition. Where the climate varies, this covering thickens on the approach of winter and becomes thin as summer advances, the creatures themselves not changing their abode. In excessively cold countries, the fur of animals is so thick and close as to be almost impervious to cold, and in the torrid regions a thin covering of hair is almost invariably found.

Man alone, moving from place to place, finds it necessary to provide himself with coverings which shall at one time protect from cold, and at another from heat; and the completeness and perfection with which this is done, is the proof of his intelligence and the measure of his civilization.

The barbarous inhabitants of the colder countries use skins of animals, those of warmer climates palm and other leaves; and as their communication with other and more civilized

people increases, these are exchanged for woven wool and cottons, which in turn change from mere wrappings to being fashioned into garments, and gradually advance with civilization to the modern European garb.

In addition to its uses as a covering for the body, and as a mark of, and aid to, civilization, clothing may be regarded as a means of adornment and pleasure both to the wearer and the beholder. Ruskin says that 'you are to see imperatively that every one has something pretty to wear,' and as long as prettiness can be combined with what is suitable to our means and position, as well as the necessities of health, we may accept this as a good rule. It applies more directly to the outer clothing, but although appearance is to be more considered in this than in the under garments, none of the rules by which these are selected should be overlooked in its choice.

It may be taken as a general rule that dark coloured garments are more suitable for cold weather than light, on account of their well-known power of absorbing heat. This fact may be tested by subjecting white and black articles to the same amount of heat, and the result will show that the black is hotter and retains its heat longer than the white. Light colours not only do not absorb heat so readily, but they have the power of repelling it.

THE COST AND PURCHASE OF CLOTHING.

Economy and suitability are to be considered in the purchase of dress, and we must first clearly understand what constitutes real economy. It is, getting the best value for the amount of money we can afford to spend; and also choosing the material that is best suited to the season in which it is to be worn, to the position of the wearer, and to the work that has to be done.

These are the principal, though not by any means the only points to be remembered when buying, and they apply equally to all kinds of clothes. Someone has said that 'It is not so hard to earn money as it is to spend it well,' but knowing that it *is* hard to earn money it behoves us to take care that it is well spent.

At the present time clothing of all kinds is cheap, at another it may not be so, and a good buyer will take care to know the average prices of various articles, and not be induced through ignorance to pay more than they are worth or less than will ensure satisfaction.

Some of the advertised 'cheap materials' and 'bargains' cannot be regarded as economical, for though they have a good appearance when new, they will not stand wear, and the result of such 'bargains' frequently is the purchase of a second article, where one, carefully chosen and of a fair price, would have answered. It may be considered a good rule that the 'best is the cheapest in the end,' for not only has it a better appearance, but in most cases it can be altered and utilized in other ways after its first purpose is fulfilled. The best of materials will certainly get spotted and soiled after being worn a good while, and many colours fade with long exposure to sun and air, even black turning brown and becoming shabby. If however they have been good in the beginning and have been treated with care, they can be dyed, and so for the outlay of a

few shillings an entirely fresh garment can be obtained. Even if the stuff shrinks, as in some cases it will, it may be utilized for a smaller person or child. Dyeing has now been brought to such perfection that a dress that has become too shabby, through dust, spotting, or fading, to be worn, can, if it is whole and of good quality, be made as bright and clean as new.

Let us lay down two rules which are to be always remembered and never broken. First--never buy anything unless you have the money ready to pay for it at the moment, and second—never buy merely ornamental things till the necessary and useful are provided.

For the first rule there are several good reasons. I shall give you three. First—it is dishonest to buy anything you cannot pay for, and you can never be quite certain that you will be better able to do so at another time. Second—it is always cheaper to buy for cash. Shopkeepers need money as well as their customers, and if they have to wait for it they are quite justified in charging interest. Third—there is great satisfaction in knowing you 'owe no man anything' and great *dis*satisfaction in having to pay for something that is worn out and forgotten.

With regard to the second rule we will ask—What are the necessary articles of clothing? They are those that conduce to our health and comfort.

To ensure these two points it is essential to have a sufficient number of garments, especially of those that are worn next the skin, to allow of frequent change and washing. However tasteful and pretty the dresses may be, if the skin is not bright and fresh the whole appearance is spoiled, and if the clothing is not clean the skin is hardly likely to be so. Even if the dress is worn and shabby, if the skin is clean and bright and the under-garments fresh and sweet, the whole will have an infinitely better effect than what can only be termed 'dirty finery.'

We have seen that flannel is the *best* material to wear next the skin, but whether it be flannel or calico no one should rest

content with an outfit till it comprises at least two, or better still, three garments of each kind. A week is as long as any under-clothing should be worn without washing, and it is not always convenient to have 'washing day' so often as every week, therefore three is a better number than two.

A good quality of flannel may be bought for from 8d. to 10d. per yd., and if flannel is carefully washed, and mended at the right time, there is no reason why it should not last for several years. After wearing it two or three winters it will last for two or three summers, having become thin.

Two yards of flannel will make a good sized vest to wear next the skin, high necked and with moderately long sleeves.

Sometimes woven woollen garments may be bought. They are more expensive, but if a good quality is chosen they will last for several years with care in washing and mending. These are called 'sanitary' flannels and sometimes by the name of the maker—'Jaëger,' and being of unbleached natural wool are considered warmer and more healthy than the ordinary flannel. Red flannel is sometimes used for petticoats. It is warm and strong, but is liable to loose its colour in washing. It is sometimes recommended as not needing to be washed so often, but that is a foolish idea, for whether it be red or black or white it will be equally dirty, though it may not show it in all cases, and needs to be washed. Besides, flannel becomes hard and felted, and so far less warm when dusty and greasy. It will take 2½ yds. for a large petticoat.

Calico may be had at various prices, but good unbleached calico, which is the strongest, will cost from 3½d. to 5½d. per yard, and white calico 5d. or 6d. Calico garments are generally made larger than flannel, and the material is rather wider.

A skirt of dark woollen stuff should be worn next to the dress, and this should be shorter and narrower than the dress skirt. Dresses, when they become worn at the edges or faded or soiled, may be cleaned, either by washing or dyeing; shortened, by cutting away the frayed edges; narrowed, by taking

out the worst portions from the width, and will then make a good underskirt. If stuff has to be bought for this petticoat, a strong, neat, striped material called linsey will cost from 8d. to 1s. per yd., and 2½ yds. will be required for a full-sized skirt. As the material is strong and will wash it is well suited for the purpose.

After the body has been well and carefully clothed, we must consider the feet, and here we come to what must always be rather an expensive item. Stockings are in such constant friction both on the foot and in the boot, that they wear out more quickly and need more care in mending than any other garment. They should be of wool, thick or thin according to the season, and the thick winter stockings at least should be home knitted. By this means better material can often be procured, and the labour of mending is lessened, for the hand knitted are not only easier to darn, but when much broken and darned can be refooted. A pair of woven cotton stockings will cost from 11½d. to 1s. 6d., woollen ones from 5d. to 1s. Knitted woollen stockings, full size, will take about 7 ozs. of wool, and cost about 1s. 6d. per pair.

Boots and shoes, however, are a still more serious item of expenditure, and one on which, if on any, a little license may be permitted. So much of comfort depends on the good fitting of a boot, and so much of health on its power of protecting the foot from damp and cold, that it becomes one of, if not the most important consideration connected with dress.

If the boots are too tight in any part, they stop the circulation and keep the feet cold, and also cause corns by the unnatural pressure. Large boots also cause corns by friction. The best leather is expensive on account of the elaborate process and length of time required to make it thoroughly durable and well seasoned.

When buying boots always go to a good shop where you can depend on getting a good article. Save on some other item if need be, but never buy cheap or inferior boots. Damp is

certainly one of the greatest enemies to health and most frequently makes its attacks on the feet. It is a wise plan to have two pairs of boots, so that one pair need never be put on until thoroughly dry, and in any case slippers or a pair of thinner, older boots can be worn in the house and so give the outdoor boots a better chance. They will always wear better and longer if well dried after wetting before being worn again, and the drying should never be quickly done or near the fire, because that makes the leather brittle and apt to crack. Some boots have the soles fastened to the uppers by sewing, others by pegging, and the sewed boots are considered the best. The pegged soles are liable to tear away from the uppers if they have been wet.

A stout but not stiff leather which will brush and polish and always look neat and bright is the best; the soft fine kids are only suitable when one has several pairs, and need only wear these when the weather is dry and warm. Choose a boot with a good broad sole, which will prevent the upper leather from tightening over the foot and causing corns and pain, besides bursting with the constant strain. And above all choose boots that will allow the toes to lie in the position they are intended for, and not pinch the whole five up in a point only large enough for two. One of the reasons for the extreme inelegance of the carriage and movements of the women of the present day is found in the absurd practice of wearing pointed shoes. It disturbs the balance of the whole body. The toe is the broadest part of the foot, and is intended by nature to support the weight of the body and to steady it while running or walking.

Now we come to the point where dress is more particularly thought of as an adornment. Every one should dress as well as their means will allow, and it is quite right that care and thought should be expended on choosing what is pretty and becoming. But it must be remembered that to be really becoming it must suit the means and work of the wearer as

well as the face and figure. Never wait to decide what is best to buy till getting to the shop, when the eye and fancy is confused with the multitude of pretty things which still are not exactly suitable. Decide before going what will be best for our purpose, and we may still enjoy the pretty things without being puzzled and misled in our choicé.

The dresses to be worn while doing housework and cleaning should be of washing material, so that the greasing and spotting, which can never be entirely avoided, may be got rid of and the dress made clean and fresh. Printed calico is the best for this, and the material for a whole dress, including the lining for the bodice, may be bought for about 5s. They should be made very simply with a plain straight skirt and a neatly-fitting bodice, not too tight, as calico shrinks a little in washing, though not so much as wool.

The colour in print must be carefully selected. Some wear and wash much better than others. Medium shades of pink, lilac, and blue are good washing colours, and small patterns or narrow fine stripes always look neatest.

For the afternoon or evening dress after rough work is done, one generally wears what has served already as a best dress. We must consider this second use when buying it in the first place, for if it is to be worn while working nothing would look worse than an unsuitable material, colour, or style. A plain simply-made dress will not be out of place in any occupation and can always be made pretty and tasteful by a little gathered lace at the neck and wrists, or a bright bow of ribbon at the throat, while nothing can look worse than frills and trimmings, which soon become fringes and rags, and cause no end of trouble while we are dusting, washing dishes, etc.—work which has to be done at all times of the day, not only in the morning or in our working dresses.

All dresses worn indoors should be protected by aprons if we wish to keep a nice tidy appearance. For the very roughest work they can be bought of coarse brown sacking for 3d. each,

and a strong holland for ordinary work will cost 6d. per yd. $3\frac{1}{4}$ yds. will make three aprons with a strong band and square bib which protects the whole front of the dress. Smaller aprons of pretty print or white or coloured muslin can be worn after work is done and will keep the best dress from getting spotted.

There are not many advantages in always wearing dark colours. Dust shows more on dark than on light colours, and although it is to be carefully removed from either, still after a time it does not come completely away, and some of the dark colours look dusty and grey even when well brushed. Also constant brushing soon makes a dress polished and shabby, and this polish or glaze shows less on light than on dark stuff. When possible it is better to shake it well whenever it is taken off and only brush the parts that have been actually soiled or spotted with mud.

Bright colours are pretty and becoming for girls if they are careful to choose those that suit the skin and hair and will not look remarkable. Avoid anything that will look peculiar or attract attention, for that is always vulgar.

It is difficult to give a general price for dress stuffs on account of their great variety. For winter one would choose woollen stuffs, such as merinoes, homespuns, serges, and winceys. They can be had at almost any price, and the width of the material will decide the quantity needed.

For summer there are prints, thin woollen stuffs and serges, sateens, and a number of mixed materials, that is, part cotton and part wool. If one dress is to be worn in summer and winter, choose one not too thick, and put on extra underclothing or wraps in cold weather.

An outdoor jacket or cloak is needed nearly all the year round. There are not many weeks in an English summer when it is wise to make no difference between indoor and outdoor dress. A warm comfortable ulster can be bought for 7s. or 8s., but a better one would last longer if the wearer is not growing much. If, however, the outdoor wraps are too tight or small,

they are not so warm and also are liable to crack and become shabby.

Hats and bonnets of straw can be bought often for a few pence and can always be trimmed at home. These, sooner than anything else, get softened and spoiled with weather, and it is never wise to spend much on them. It is better to buy a fresh one, when they are so cheap, than to spend time and money on altering, or perhaps continue to wear an untidy hat because it cost so much that a new one cannot be afforded. Felt is a good material for a winter hat; it needs hardly any trimming and does not spoil with rain, while dust can be easily brushed off. A felt hat will cost 2s. or 2s. 6d.

All clothing must and does wear out in time; parts of it do so very quickly. Remember that 'taking care' and timely mending will make it last longer and look neat to the end.

THE SOURCES AND MATERIALS OF CLOTHING.

THERE are two sources from which our clothing materials are drawn. From the Animal world we have wool, silk, fur, and leather; from the Vegetable world, flax and cotton. **Wool**, which in its simple or mixed form is one of the principal fabrics used for clothing, is manufactured from the fleece of various kinds of sheep. It is probably one of the earliest known materials, and is considered to have been brought into this country by the Saxons. Imported wool was unknown here until about the year 1790. Up to that date all the wool used in England was prepared from English sheep. Now however by far the larger quantity is brought from other countries.

For the ordinary purposes of manufacture the British wools

are unrivalled, but they are inferior in fineness to many of the other kinds. Among them the South Down breed is noted for its fine wool. It is said that the Romans established a mill and factory at Winchester for the manufacture of cloth from this wool, and it was so highly esteemed that it was reserved for the use of Emperors only. It is a curious fact that when these sheep are imported into the West Indies they deteriorate rapidly, and their wool changes into short, harsh, brown hair. The wool is from two to three inches long.

British wool is nearly twelve times as coarse as that of the Spanish and Saxon Merino sheep, which take the precedence of all European breeds for the fineness of the fleece. These again yield the palm to the Llama and Angora goat, and the finest of all wool is that of the goat of Thibet, from which Cashmere shawls are woven.

The principal woollen manufactures are in Yorkshire and the West of England. It is spun into two distinct classes, woollen and worsted goods, the latter being principally made from the long-fibre wool of English sheep.

Silk is produced by a small spinning caterpillar called the silk worm, which came originally from China, but which has now become acclimatised in nearly all parts of the world. It is propagated from eggs, and reaches maturity very quickly when it at once begins to spin.

The supply of silk is contained in two glands, one on either side of the body. The two threads are glued together and wound into a nest, which is called a cocoon. When it is completed the caterpillar is removed, the silk unwound and tied into hanks, in which condition it is called raw silk, and is afterwards woven into various forms.

Dress silk is chiefly manufactured in France; in Spitalfields, a part of London formerly inhabited almost exclusively by French refugees, who established themselves there after the Revocation of the Edict of Nantes, and in Macclesfield; ribbons in Coventry and Derby; handkerchiefs in Manchester,

Macclesfield, Paisley and Glasgow; stockings and gloves in Nottingham.

The manufacture of silk is of great antiquity, but was only introduced into England about 1455.

Fur is principally supplied to us from the animals which inhabit the colder parts of the world, though some of our own home animals also furnish a fur which is, however, not considered of much value.

Those chiefly valued for their fur are the **Marten** or **Sable**, **Chinchilla**, **Ermine**, **Arctic Fox**, and **Lynx**. The skin of the **Seal** is also regarded as fur, and of a very valuable kind.

Squirrels, which are produced very largely in Russia, furnish a useful fur which is principally used to line garments, the tails making trimmings and boas.

Cats also, when bred for the purpose, yield a durable fur, and the **Wild Cat** is still more valuable on account of the length and softness of its hair.

Rabbits and Hares are also used and their fur has a great variety of colour, being black, white, grey, and blue.

Leather is the skin of animals, with the fur removed by a process in tanning. It is used in clothing for coverings for the hands and feet.

Those principally used are ox and cow hides, for soles of boots, and horse and calf skins for the upper parts of boots. Lamb, deer, dog, cat, and even rat skins are used, under the general name of kid, for gloves.

They are prepared by a process called tanning, which adds very much to their durability, and renders them comparatively imperishable. The full process of tanning occupies from twelve to eighteen months, and the quality of the leather depends on this being carefully carried out. A much quicker method is sometimes used, but the leather is not nearly so durable by this 'hot,' as by the longer or 'cold' process.

Other leathers, which are not very often used for clothing,

are prepared by a process called tawing. They are—**Morocco**, made from goat skin, used sometimes for the uppers of boots, and for bags, &c. ; **Roan**, used for bookbinding ; **Chamois** or **washleather**, used for cleaning glass and silver, and sometimes for lining garments ; **Russian**, used in bookbinding and the manufacture of fancy articles.

Large tanneries are found in the neighbourhood of Bermondsey, but the manufacture of leather is general over most parts of the country.

Of the vegetable products used for clothing, **Linen**, as the oldest, may be considered first. It is obtained from the fibres in the stems of the flax plant, which is grown very extensively in the North of Ireland, to a less extent in Scotland and England, and in Belgium, which country is especially famous for its growth and manufacture.

It is one of the oldest textile fabrics of which any record is to be found, and its durability is proved by the fact that the Egyptian mummies are wrapped in linen cloths, some of which have been used and washed several times, though known to be 1,500 years old.

Until about 100 years ago linen was the only fabric of the kind used, but since the introduction of cotton about that date, its use has been gradually dying out for underclothing, and except for collars, cuffs, shirt-fronts, and in the form of cambric and lawn for handkerchiefs, &c., is rarely used in its simple form of **white** linen.

It is a good conductor of heat and has a cold feeling on the skin, which makes it unpleasant and unhealthy in any but the very warmest weather.

Linen is, however, capable of taking a good dye, and it is now used for summer dresses, for which its coolness renders it particularly suitable. **Holland**, which is one kind of linen, is used for dresses and aprons, and is much smoother and stronger than cotton.

Linen is almost exclusively used for dressing wounds, its

smoothness and the absence of the fluff found in cotton rendering it specially suitable for that purpose.

Calico, which has so largely taken the place of linen, is a manufacture of comparatively recent times. It is obtained from the downy covering of the seed of the cotton plant grown in tropical countries and in some of the warmer parts of North America.

It is much more suitable than linen for underclothing, from its greater softness and warmth, and may be placed next to wool as an absorbent and non-conductor. In its first manufactured form it is used for a great variety of purposes besides clothing, and when printed and dyed forms one of the materials chiefly used for summer dresses.

The chief manufacture of cotton is in England, but recently it has been extending to other countries, and quantities are now exported from America. The great seat of cotton manufacture in England is Manchester.

THE CARE, REPAIR AND CLEANING OF CLOTHING.

When provided with a suitable outfit the next point is to keep it in good condition, and this needs constant attention. **Dust** should be removed each time a garment is taken off by giving it a gentle but thorough shaking. Then if it is carefully folded and laid away, or in the case of dresses and jackets hung up, it will wear better and keep a good appearance longer than if tossed carelessly aside. **Damp** causes mildew, gives them an unpleasant odour, and makes them liable to crease and become lined; therefore clothes should be carefully and thoroughly dried.

If a little time and care is given frequently to keeping clothes in repair we shall far less often be troubled with 'mending days.' 'Prevention is better than cure,' and in no case more than in the care of clothing. A thin place is always easier thickened than a hole is mended; and thin places are kept away for a long time if 'prevention' is brought in to strengthen those parts likely to wear first.

Take, for instance, **Stockings**, than which nothing requires more, or more frequent, mending. The holes that make stockings a terror to the darner may be kept away for a long time if toes and heels, the parts that wear so quickly, are carefully run before they are worn at all. These parts in woven stockings are frequently made double, and can be made so in hand-knitted ones; but even then a smooth running before wearing will render them stronger and less liable to fray. The running should be in one direction only, not crossed as in darning, and always the long way, or with the rib of the material.

Still, in spite of care and running toes and heels will come through at last, and then much, both of comfort and economy,

depends on the darning. Stockings should be taken off the foot as soon as a hole appears and washed before mending; almost the only repair that need not be made before washing. When washed and dried draw the edges of the hole together easily with a fine thread the colour, or as near the colour of the stocking as possible. By 'easily' I mean without straining or drawing the material out of shape. A great help in avoiding this straining is to use a hard, polished, wooden egg instead of the hand. This or something of the same kind is always used on the continent and is becoming very general here. It may be bought at a fancy shop for two or three pence, but if it cannot be procured the round end of a soda water bottle answers the purpose well. This is used by sailors for darning on.

If a piece of the stuff is torn away the edges cannot be drawn together; but if they are only parted, not torn, when drawn together in this way there will only be a thin place to darn instead of an actual hole to fill.

The darning must be very carefully done or rough places will irritate the skin and cause pain or perhaps corns. If a new hole is found near an old darn, it is worth while to draw out the **cross** threads of the old darn and extend the first one over the whole thin place rather than make a second darn, which would cause the surface to be uneven. This is always easily done if the threads in darning are drawn smoothly and have good loops left at either end. These loops should be cut when the darn is finished, for the cotton or wool being unwashed will shrink and tighten, causing a pucker and a fresh rent.

Boots and **Shoes** must be kept from needing mending by careful usage. Never put on a pair of boots after rain until they have been well and carefully dried. Boot makers are often blamed for selling poor goods, when the fault is in the wearer. Water always softens, and if not dried off at once rots the leather, and any strain put on it while so softened must result in tears and rents. To keep them in good order never

allow boots that are damp to stand on the soles; either tie the laces together or, if not laced, loop a string through the button holes and hang them in a dry room or a current of dry air. At least let them lie on their sides. If left standing, the damp, unable to escape, will force its way through the sole into the boot, making it a much more difficult matter to dry. When they show signs of cracks have them repaired at once; a small patch is less unsightly than a large one, and it will soon become a large one if neglected. The soles and heels should be mended before they are too much worn, for if once softened and broken the strain weakens the upper leather and it will not stand the strong new soles. Good boots, if they are carefully treated, can be soled two or three times.

Underclothing should be either darned or patched; darned if the thin place or hole is quite small, but if large, darning would be waste of time, and patching both easier and better. Cross seams are always liable to crack and should be re-sewn at once, or the stuff will split across. When a patch is necessary, cut the broken part away entirely; it will not be strong enough to bear the new material and would only cause a fresh and worse rent. These patches must be very carefully planned and neatly worked. If the new piece is not laid on the garment evenly by the thread, it will be difficult to sew it without puckering; and if not laid the right way of the stuff, that is with the selvage running down, it will stretch and form an 'elbow.'

Underclothing should be examined and mended before washing, or if a great deal of mending is needed should be drawn together to prevent further tearing, and properly mended when clean. These garments should be 'rough dried,' *i.e.*, not ironed or starched.

Dresses.—Darning is sometimes better for dresses than patching, as they are more liable to get small tears than to wear out, and unless a large piece needs repairing a patch would be unsightly. When, however, it is necessary to patch,

cut away the torn part entirely and try to make the patch as nearly like a seam as possible. A patch across a skirt always looks bad, though infinitely better than either a tear or a darn; but if it can be planned to run down instead of across, it simply becomes another seam and unnoticeable.

Pieces of the material over from making all garments should be saved for mending, and in the case of dresses for dyeing, so as to have the right colour for altering or patching. Where small darns are needed on dresses, if the exact colour of cotton or wool cannot be got, a piece of the new stuff frayed out will give a thread strong enough, with care, to use for the purpose.

Now a large portion of our clothing is of washing material, and if it is to be healthy, comfortable and well kept, we must understand how to clean it.

Washing is neither an easy nor specially pleasant occupation, but as it is absolutely necessary it is well to know the best and quickest way of doing it effectually. It is always well to have regular times and seasons for regular work, otherwise the comfort of the household is disturbed and the work is ill done; and this is especially necessary when the work is washing, for the whole household is more or less involved in it.

A certain time must be set apart for the work, and the work *must* be done in that time. Nothing is more unpleasant, or so much a sign of bad management, than an appearance of washing about after two days, even when the family is large; and the actual washing or cleaning should be finished in one, leaving if necessary the ironing and finishing off for the next day.

In order to accomplish this a little forethought and arrangement is needed. There are preparations to be made which do not take long, but still long enough to hinder and delay the actual work. The circumstances of the household decide the best day for washing, but as a general rule Tuesday is the best. Monday always has a little extra work already after the rest from all unnecessary toil on Sunday, and the preparation is to be made the day or night before. It is not always possible or

advisable to prepare on Saturday, as it may cause a certain inconvenience unless the appliances are exceptionally good, such as an outside wash-house, a large number of tubs, &c.

We will suppose the washing to be on Tuesday; a little time must be spent on Monday in getting all in order, to avoid waste of the best part of the day, the early morning. First, so arrange all the work and meals for the following day that there shall be little or no need to leave the clothes except for one's own meals; by working hard and closely for the time, it will be sooner over and the labour less. Then collect *all* the things requiring to be cleaned. Nothing is more vexatious after working hard and getting forward than to have a few more soiled articles discovered. The work is almost as much for one or two pieces as for ten or twelve, and annoyance can be excused when so much unnecessary trouble is given through carelessness. Let nothing be overlooked, and when all is collected begin sorting, that is, separating the pile into smaller heaps, each of which shall contain only one kind of article. First the **flannels** must all be picked out, taken out of doors or into a back kitchen and well shaken. This is to loosen and remove the dust which settles in the thick soft fabric, and which if wet would turn to a species of mud, discolouring the flannel and very difficult to remove. Roll each garment up tightly when shaken and lay them aside out of the way of damp. Second, the **coloured prints** and calicoes must be put aside, also dry. Third, **table-cloths, tray-cloths, finger napkins**, and everything connected with the table or food. Fourth, all the **bed** and **underlinen**; and if you have a sufficient number of tubs or pails, this heap may be divided again by putting the **white shirts** and starched **collars** and **cuffs** apart to avoid any risk of the old stiffening getting into the unstarched clothes. Fifth, **handkerchiefs.** Sixth, **bedroom towels, toilet covers**, &c. Seventh, **kitchen towels** and **dusters.** Eighth, all the **coarse rubbers** and cloths that remain.

These piles of white or undyed articles should be put into

separate tubs or pails, or the smaller heaps even into large basins, covered with cold water and left to stand 12 hours; if you have not room enough or vessels enough for this you may put all except table-linen, handkerchiefs, and kitchen cloths together in one tub. The handkerchiefs *must* be kept by themselves, and the table-linen should never be allowed to mix with any other articles until all have been washed, as the grease and dirt from coarser things would spoil the finer. Besides, these rougher things are the better for a little soda in the water with them, and that would spoil the others.

Cold water will soften the dirt in all these unless they have been allowed to get very dirty; then, a little soap rubbed and left in the soiled parts will help. For the very coarse things take a piece of common washing soda as large as a walnut, pour on it a jug of boiling water, and when quite dissolved add it to the clothes with enough cold water to cover them. If the soda is not dissolved in boiling water—warm will not do—it burns and discolours the clothes, and will leave marks like iron-mould, which will eventually become holes.

When all are covered with water the preparation as far as the clothes are concerned is finished. If it is planned beforehand, and everything is in its right place, such as soiled linen in one proper place and not in half-a-dozen, of which some are sure to be forgotten, the whole work need not take half-an-hour. If the kitchen has to be the wash-house it can be done when the rest of the family are in bed. For the rest, see during the day that the tubs are quite clean and empty, that the boiler is filled, and the fire laid. Melt the soap for the flannels by shredding as much as will be needed for the number of pieces to be washed into a jar or pan and covering it with water, then setting it near the fire or in the oven to dissolve; it should not boil, for that wastes its strength, but just gradually melt into soap-jelly. Get soap, soda, &c., all ready and at hand, so that there may be no time lost in the morning.

If there has been any sickness in the house, even colds, it is

wise to add to each gallon of water used to steep the clothes one table-spoonful of liquid Sanitas, which is a strong disinfectant and destroys the disease germs, so preventing the infection being carried to any one else through the contact of the clothes. It should be used in the same proportion, in the water in which flannels and prints are washed, as these are not steeped.

When washing day arrives **rise early.** No good drying will be done late in the day, except in the height of summer, and the whitest and sweetest clothes are those that get the freshest air.

Having all preparations made, light the fire and soften the soap-jelly for the flannels, or it may be kept soft by standing in the oven all night. As soon as the water is warm, not hot, take out a pailful and pour into it enough melted soap to make a good lather. Then plunge in the cleanest and whitest flannel, one piece at a time, and knead it about in the lather till all the dirt is worked out. Remember flannel must not be rubbed, for that will make it hard and stiff, and the warmth of flannel is in its softness and elasticity ; and it must not be put into either hot or cold water ; both cause the flannel to shrink, and cold water will not remove the grease. It should be tepid or lukewarm, just a pleasant heat on the hand. When quite clean—and it must have a second lather if one does not make it so—rinse well in lukewarm water, wring very tightly—through a machine is best—then shake well on both sides, and hang it out to dry at once. A breezy day is the best, but if it should unfortunately be wet, hang them in front of, but not too near, a good fire. If the heat is sufficient to cause steam, it will make them shrink and thicken. After the light-coloured flannels are done, the same lather may do for the dark ones ; but if the froth has disappeared or the water seems dirty, take entirely fresh. Coloured stockings, either cotton or woollen, will be washed like flannel except that the feet must always be rubbed ; they may be done after the flannel. They should first be washed on the right side and then on the wrong, and left wrong side out ready for mending.

Next come the prints. If they are new or fine they will also

be washed in lukewarm lather, and if the colour runs at all they must be rinsed in cold salted water after washing; salt has the power of setting and hardening the dye. If they are not new and the colour is fast, they can be washed by rubbing on the soap and scrubbing between the hands, and rather hotter water may be used. They must not be left longer than is necessary in the water, as that will draw the colour even from old prints. Dolly tubs and pegs are useful for dresses and large pieces, as they rub the dirt out more quickly and with less labour, and only the specially soiled parts need rubbing by hand, such as bands, cuffs, and sometimes the edges of skirts. Hang them to dry as soon as possible, and keep them out of the sun if it is very strong.

The white clothes which have been steeping will be the next, and of these take first the table linen, so that it may be finished before the more soiled articles need to boil. Rub it in the steeping water till the dirt which has been softened by steeping is rubbed out. Then lay it in water as hot as the hand can bear and rub it well with soap, paying special attention to stains or spots. Stains, however, should be removed as soon as made, as after they dry they are more difficult to take out, and washing nearly always hardens them. When quite clean rinse the linen well, place it in the boiler with a little melted or shredded soap, and keep it boiling well for about half-an-hour. Then take it out and rinse well, first in clear and then in blue water, and wring tightly. If any soap is left in, it will discolour when the hot iron is laid on it, and will also have an unpleasant smell.

Hang the things out carefully, catching them firmly to prevent slipping and getting soiled, and not too near the corners, which are apt to tear. Let the air get freely about them, for that is the great sweetener. If the day is too wet to put the clothes out, the white things must be left lying in plenty of clean cold water ready to wring out on the first opportunity. This keeps them a good colour and prevents any close smell

Proceed in the same way with all the white clothes, leaving the dirtiest till the last and using for the coarser ones a little soda prepared in the same way as for steeping them. If soda is not first dissolved in boiling water it will burn and destroy the material, being a very powerful alkali.

When the last clothes are finished, scrub the wooden tubs and pour away all the water, then put in a little clean cold water and leave it till wanted again; this prevents the wood shrinking and the tub leaking. Dry away all the water from the boiler, for if the least damp is left it will rust and spoil the clothes next time. Being warm, if the water is all taken away it will dry itself, and should then be covered to keep out dust. All zinc or metal tubs must be well dried and turned upside down to keep clean. See that the floor is washed and dried and everything in its place before the clean clothes are brought in, or you will hardly be able to keep them nice. Have a large basket or clean table on which to lay them as they dry, where they can be out of the way of splashing and covered from dust till the room is ready.

Unless the washing is very large and the whole day is required for cleaning, a good deal may be done on the same day towards finishing off. The clothes should be taken from the lines in different stages of dryness. Everything that is to be starched should be perfectly dried, and also everything requiring mending before being finished. Flannel should be dried perfectly, aired and put away at once, as it absorbs moisture easily and may become damp with steam. Other things, which are to be mangled or ironed should be taken in rather damp, folded neatly, and rolled away to finish later; they will not smooth well if too dry. Handkerchiefs need only be hung out of doors to sweeten and freshen; they need no drying beyond tight wringing, and if they do dry should be rinsed through clean water, tightly wrung and rolled away for ironing. If they are ironed quite damp they stiffen and keep longer clean. These can quite well be ironed the day of

washing unless it becomes too late. The fire to air the flannels will heat the irons, and the labour of ironing handkerchiefs is not great. The smaller table linen also, unless it is to be starched, can be ironed damp at once. When these smaller articles are away the larger are more quickly disposed of. If possible the starching should be done the first day, as the linen is much more easily ironed if starched some hours before.

Shirts, collars and cuffs all require cold water starch, as they are to be very stiff, and by cooking the raw starch with the hot iron in the linen, they become stiffer. Dresses, aprons, curtains, laces, and muslins need only slight stiffening, and are done in boiled or hot water starch; by cooking it first in boiling water it only dries in the stuff and stiffens it sufficiently.

Everything starched in cold or raw starch should be rolled up tightly in a clean cloth and pressed, then laid away for a few hours before ironing; they can, however, be ironed at once if necessary, but not so easily and smoothly.

Things starched in boiled starch should be perfectly dried, then sprinkled with hot water and rolled away till evenly damp, when they will iron easily.

Stockings are to be dried and aired and drawn roughly together till mended.

Bed linen is carefully folded edge to edge, and mangled while damp; table linen, if not starched, is to be treated in the same way, but should be ironed after mangling, and both should be thoroughly aired and folded away.

Body linen will look better if it is mangled first and afterwards ironed; but one process is sufficient, if time is limited, always preferring ironing, for it makes the things smoother and they keep longer clean when smooth.

Towels, dusters, and coarse cloths should be neatly folded and run through the mangle, but require no ironing.

The number of articles to be starched will decide the quantity to be made, and cold starch should be mixed in these proportions:—To each tablespoonful of starch allow one

breakfast cupful of cold water, half a teaspoonful of borax dissolved in a very little boiling water, four drops of turpentine to the first, and two drops to every additional cupful of water. Too much turpentine gives an unpleasant smell to the linen, but the right proportion will prevent the iron sticking. Put the starch in a bowl and break it with a little of the cold water, using the fingers to rub out the lumps. When quite smooth add the rest of the water, the dissolved borax and the turpentine, and it is ready to use. Stir it up each time, the starch being heavy sinks to the bottom.

If much cold starch is left over it may be allowed to stand a few hours, then if the water is poured off, the sediment can be used for boiled starch. If there is not enough, mix the fresh dry starch with a little cold water to the consistency of cream, in which state it is like the sediment from the cold starch, add a small fragment of tallow from the end of a common candle, and pour on boiling water till it clears and becomes thick. It must be stirred all the time to prevent lumps forming. This can be made as thin as required by adding more water, either hot or cold, after it is cleared and cooked. Add half a teaspoonful of borax dissolved in boiling water to each tablespoonful of starch used; it helps both to stiffen and glaze the linen. The tallow in boiled starch answers the same purpose as the turpentine in cold. Both kinds will keep some time if covered, and if liked can be made during the preparation for washing.

If all the starching and folding can be done on the evening of washing day there need be no danger of having the clothes about after the second morning; but of course if the amount of washing is too great, a whole second day must be devoted to the finishing.

When ready to iron see that a clean bright fireside is made before the clothes are brought near or uncovered, for after the labour of cleaning it will be annoying to find dust or smut on them. Keep a good fire burning to save waste of time and

fuel, for a large well-built fire is hotter and lasts longer than a small one which needs constant making up, besides the less risk of having dust about.

The irons must be carefully kept from one time to the next in a dry warm place where they will not rust. If they are not to be used for a good while rub them while warm with mutton fat, which hardens on them and forms a casing to protect them from damp. If they do get rusted rub them with sweet oil and leave it on for two or three days, then clean them with bath brick and rub them on a smooth hard surface, when they should be ready to use. There are several kinds of irons, but the best are the common flat or sad irons, to be heated in front of a fire. Box irons are troublesome because the constant raking of the fire to find the heaters causes a great deal of dust besides wasting the fuel.

Have a piece of smooth board kept for rubbing the irons on; they get smoked and roughened sometimes with the fire and starch, and scraped bath brick on a board will soon make all right. A coarse rubber must be beside it to dust the irons and make all clean before they are taken to the table.

The table for ironing should stand very steadily and be large enough to hold everything needed without crowding. Cover it with a thick flannel or piece of felt, and that again with a clean smooth sheet, both of which should be free from joins or patches, as the seams would leave marks on the ironed linen. Place on the table before beginning a small basin of clean water, two or three pieces of white rag, and a stand for the iron; then you will not be hindered looking for them when they are just wanted.

Ironing should be very quickly done, as the irons cool fast, and unless quickly handled very little can be done with one, and the constant changing and cleaning make it a longer and more tiring process.

Starched clothes should always be ironed by daylight, as they require hotter irons, and more readily singe than the unstarched,

and singe is not readily seen by gaslight. Daylight is best for all ironing, but the plain work may be left more safely.

Table linen should be ironed on the right side, as that throws up the pattern and brightens it. The small pieces can be ironed on both sides. All must be carefully and exactly folded, laying selvage to selvage, not hem to hem. Press the folds in with the iron and hang it to air.

Body linen is ironed on the right side, carefully folded and pressed, then aired. Bed linen is very exactly folded, and mangled only, though the smaller pieces such as pillow cases are sometimes ironed. Handkerchiefs are ironed all over both sides till quite dry, and carefully folded square to bring the name on the outside.

Starched linen should be rubbed over both sides with a dry rag to smooth it, ironed a little on the wrong side, then on the right till dry, smooth, and stiff. Shirt fronts are ironed only on the right side because of the difficulty in turning them without crushing. They are then ready for airing, but are much improved by being polished or 'glossed.' This is done by damping the finished surface of the right side with a clean wet cloth until all the brightness left by the iron is removed, then rubbing it vigorously over backwards and forwards with a 'glossing' or polishing iron. This is a small iron, the smaller the better, with a rounded surface faced with fine steel; it must be kept very bright and smooth and well heated, and when used in the way described will give a beautiful smooth surface to linen, which keeps much longer clean when polished than when simply ironed.

Prints are ironed on the right side unless the pattern is raised or dull, when the ironing should be on the wrong side, the iron always smoothing and polishing the surface it is in contact with.

Muslins and laces are always ironed on the wrong side, as they are never bright. They should only be very slightly

stiffened, as the threads are fine and would crack if too much starched.

A shirt is the most difficult article to iron really well, and requires a great deal of practice. I will describe the method, and if a shirt is ironed well, one may be pretty sure that other things, being simpler, will succeed also.

Fold it down the middle of the back from collar to hem. Lay it on the table and iron all over the two halves of the back. Fold the front in the same way and iron all except the starched breast. Now fold it by the side seams and iron the sleeves, double and on both sides, and down the side seams. Then rub the starched parts and iron first the cuffs, then collar or band, and last the front. The front should be ironed on a board covered with flannel and slipped inside, which gives a smooth hard surface to work on. In ironing the front pass the iron from the neck to the waist and from the middle to the sides, to avoid creases forming in the middle.

Now there are various articles used in laundry work which require great care; they are good if properly, but very bad if improperly, used. First, soap must be carefully selected. Only white or, strictly speaking, yellow soap should be used in the laundry. Mottled soaps discolour the linen, often containing so much soda as to be injurious. There is no economy in buying cheap soap or small quantities. Cheap soaps are often badly made and waste quickly, and soap that has been kept some time, cut up and in a cool place, will be harder and therefore go further than fresh soap, which has a great deal of water in it. Keep a stock always drying if you can afford it, and you will save nearly half the money.

Soda is a very valuable substance in the laundry, but a very dangerous one if carelessly used. It is a strong alkali and has the power of burning if brought into direct contact with damp cloth. It will extract the colour from dyed material and gives a yellow singed appearance to white stuff. This yellow is actual burn, and will soon wear into holes. If, however, it is

dissolved in boiling water, and not used too strong, it removes grease and softens dirt in undyed stuffs. If too much is used, white clothes become grey and old looking, and lose their clear colour.

Blue helps to bring back some of the clear colour which linen and calico lose through wear and age. It should be carefully used, or it makes the linen streaky and spotted. It is a heavy powder, and if allowed to settle in the vessels will colour the clothes unequally; it should be well stirred up each time it is used. Remember, if too much is used it is very difficult to remove, and several washings and boilings will be necessary to bring back the colour.

Washing powders are many, but are all better avoided in the laundry. They all contain more or less soda, and as one does not know how much, it is better to use the pure thing at once; besides, soda is much cheaper than washing powder and goes further.

There are various kinds of washing machines, which save a good deal of labour if much washing has to be done. They must be carefully examined and understood, or they may injure and tear the clothes. A more generally useful utensil is the wringing machine, which also answers for mangling. This saves a great deal of the hardest and slowest part of the washing, and by squeezing the clothes evenly prevents a great deal of straining and tearing sometimes unavoidable when they have to be twisted by hand wringing. Flannels especially are very liable to crack when twisted, and yet unless well wrung take so long to dry that they shrink and thicken.

Clothes lines, pegs, and poles are all essentials if any outside drying is to be done, and tubs and boiler are necessary for good work when there is more than a very small amount. Dolly tubs and pegs are most useful for large articles, such as blankets, sheets, &c. All these, however, though good and useful, and a saving of time and labour, are not by any means indispensable. In fact, it is quite possible to do the weekly

home washing with a very small supply of utensils if a little knowledge and goodwill are brought to bear on the matter. Forethought to prevent waste of one's own strength and time, with energy and method to prevent unnecessary annoyance to other people, are much more essential to successful results in laundry work than an outfit of the newest labour-saving contrivances combined with hap-hazard arrangements and a disinclination to 'do one's best.'

Section VI.

HOUSEHOLD MANAGEMENT, EXPENSES, AND INVESTMENTS.

By MRS. BURGWIN.

Member of the Executive, National Union of Teachers; Head Mistress Orange Street Board School, Southwark.

HOUSEHOLD EXPENSES AND INVESTMENTS.

There is perhaps no lesson harder to teach or more difficult to acquire than that of appreciating the true value of money. Herein lies the secret of a happy and contented life. How often is a youth on entering life told by all, 'Now mind you get on in the world,' which interpreted means make money. This may be done and the life spent in making it may, so far as true happiness is concerned, be a failure. How then is the true path to be discovered?

First, then, the child should start earning in that particular walk of life to which he or she seems specially fitted; for instance, only those who can readily acquire information, and have a strong love for children should ever begin the life of a teacher. Once started as a wage-earner it is well to understand that not the mere possession of money, but the spending and proper investment of it, so that the greatest amount of happiness is secured, should be the aim of all.

Looking into the labourers' cottages now and comparing them with what they were twenty years ago, one cannot but feel thankful to see the comforts which now surround them, and yet on closer inspection one regrets to see that the increased wages have not been always spent to the best advantage. To effect this, children in the schoolroom must be taught to discriminate between what is merely pretty and what is both useful and artistic. What, for instance, is the enjoyment of covering the top of a chest of drawers with cheap useless ornaments, or the backs of the chairs with tawdry antimacassars? Here is perfect waste of money, because time spent in dusting should be regarded as money badly spent. Again, the windows are often carefully draped with blinds and curtains so that no fresh air can possibly get in or out. Even health is sacrificed to the love of useless finery. No one wishes to banish the little

luxuries of life from the homes of the toilers, only to teach them how best to spend money in their purchase. Contrast the homes of two workmen whose wages are identical. Here, the wife, before purchasing, considers carefully whether her means will allow her to purchase a carpet, and, if so, what kind it shall be; finally she decides upon a good thick square of felt, which can be easily taken up, turned about and well shaken, and is of a durable colour and quality. Her neighbour considers it 'very dear,' 'likes a thing to look nice,' and so buys a gorgeous coloured thin felt, and in the end finds her carpet in rags before her friend's has begun to show signs of wear. This is the difference between spending money prudently and thoughtlessly. And if these two homes were watched it would be seen that whilst in the one there were cleanliness and cheerfulness, in the other ragged untidiness and continual complainings prevailed.

There has been an increased tendency on the part of all sorts and conditions of men to live above their means instead of restricting their expenditure to a sum strictly within the limits of their respective earnings. It is sad to see how many spend the earlier years of their life in making their later ones miserable. Do not therefore now squander money on appearances.

Teachers must, if they are efficiently to carry on their noble work, be free from any haunting dread of an unprovided-for old age, for only in a cheerful spirit can the young be well taught. It must be admitted that there are still such low salaries offered here and there as to make it impossible for the teacher to maintain herself physically and intellectually fit for her work. We can but hope that these instances will in a very short period entirely disappear. A teacher must divide her income in a fair proportion between the necessary expenditure for board and lodging, clothing, holidays, intellectual reading, and savings. No hard and fast line can be laid down as to the exact amount which should be paid for board and apartments, as the cost varies in town and country, lodgings

being much cheaper in the latter and salaries generally proportionately less. But supposing a teacher receives £70 per annum she might allow for board and lodging £39 8s. (this is at the rate of 16s. per week for 48 weeks and 4s. 9d. per week during the 4 holiday weeks); for clothing, £8 10s.; for holidays, £5 10s.; for books and periodicals, £2 1s.; for savings, £10; for amusements, £1; for washing, £2; charities, etc., £1 10s.

Where a school-house residence is not provided, it is certainly wiser for teachers to board with a respectable family than attempt doing it for themselves, as by this means a far greater variety of food can be thus obtained. With regard to clothing, too much stress cannot be laid upon the necessity of wisely purchasing suitable garments, remembering always that cheap goods are generally the dearest in the end. Let the dress suit the occupation of the wearer and the climate in which it is worn. Light coloured woollen materials, suitable to the agricultural districts, would be extravagant wear in the 'black country;' again, if located in a rainy district care must be taken to buy unshrinkable goods.

All this shows the necessity of early learning the true spending value of money. Now, if the teacher has acquired this art and teaches it by precept and example, he cannot fail to be a benefactor to all around him. He will begin inculcating this teaching on even the young scholars, not that they may strive to become merely rich, but that they may live contented and independent lives. 'Cut the coat according to your cloth,' that is, live well within your means, insisting that something must be saved for the inevitable rainy day. This early cultivation of thrift inspires, too, a vigorous, manly independence, something to urge one on to grapple with difficulties which might otherwise seem insurmountable. The recipients of small incomes are only too apt, at the cost of much solid comfort and self-respect, to ape the habits and emulate the outlay of those who are in reality far better off than themselves. More

particularly the sons and daughters of well-to-do parents, young candidates for matrimony who have been brought up, so to speak, in the lap of luxury, but are dependent upon others for the very means of their existence, are given to insist upon starting in married life from that point of well-being which constituted the goal of their progenitor's labour and ambition, rather than subject themselves to the slow and toilsome process of climbing step by step the ladder that leads to wealth, or even to independence, patiently enduring meanwhile the petty privations and small humiliations incidental to that gradual ascent. There is always a feeling of sadness mingled with contempt when we see any class of society apeing the expenditure of the class above it. The children of the elementary schools should ever have impressed upon them the true dignity of labour, and when this is properly understood much of the genteel poverty of the masses will disappear. The son of Vulcan will leave the desk and turn to the forge, whilst the healthy, honest girl will leave the ill-paid needlework factory and enter domestic service, there to fit herself to manage a home with credit to herself and comfort for those in it.

If the home of the working man is to start fairly, both the wife and husband should have saved at least £20. This will furnish three rooms comfortably, allowing £6 10s. for the parlour, £7 5s. for the bedroom, £2 10s. for kitchen, and £3 15s. for utensils. Let the parlour mean the living room of the family, not a room merely set apart decked with useless finery and ornaments, to be opened only on the entrance of a visitor. The gain in health alone would compensate for the wear and tear of the furniture.

To avoid disappointment it is well to early impress upon the youth that the market for unskilled labour is already overstocked; given a trade, he can manfully start life in the hope that he will be able to earn his own living.

The evil habit of getting into debt must be carefully eschewed, for once contracted it is very hard to get free again

The ready-money purchaser has, of course, the best chance, as he is able to go, cash in hand, to any shop where he can spend it to the best advantage. The artisan's wife must carefully consider economy in small details; for instance, in purchasing dress material she should buy such as will turn and make up for a young child, and endeavour, too, to purchase in quantities all dry goods, such as soap, soda, candles, rice, tea, etc., as a saving is thus effected. Money should be saved so that coals can be bought in the summer months, when they are at their lowest price.

Supposing the average earnings ot an artisan be 30s. per week, and he has a wife and two children to support, he will probably spend on food, 16s. 6d.; on rent, 6s.; on clothing, 3s. 8d.; on firing, 1s. 6d.; on school fees, 4d.; on sundries, 1s.; and save 1s.

Having insisted upon the duty of saving money it will be well now to consider how the money saved should be invested, for the old truism holds good—'money makes money.' Yes, and *will* makes the man. Men are distinguished from each other by the exercise of *will*. One is successful and another unsuccessful because each *willed* to be so. Thrift requires a continual exercise of will, exactly as total abstinence requires it; but will strengthens by use, acts frequently repeated become a habit, and habit develops character; and a character acquired by the practice of thrift brings in its train regularity, patience, perseverance, and eventually the ability to be charitable. Having begun to save, you look about for a safe investment; hence the necessity of Banks. Bankers are persons to whom you lend your money, and they pay you interest for the loan.

There are two kinds of interest, simple and compound. When money is put out at simple interest, the investor is expected to draw that interest every year, and use it for his own purposes; but compound interest supposes that the interest, instead of being drawn, will be added yearly to the principal. As for example, £100 put out at 5 per cent. simple interest

would always remain the same; but £100 put out at 5 per cent. compound interest would in 14 years and two months double itself, *i.e.*, become £200. In short, *any* principal sum will be doubled at the following rates of interest per cent. per annum, in the various periods specified:—

By compound	int.	£100 at	$2\frac{1}{2}$	p.c.	per ann.	will be doubled	in	28 yrs.	6 mths.
,,	,,	,, ,,	3	,,	,,	,,	,,	23 ,,	5 ,,
,,	,,	,, ,,	$3\frac{1}{2}$	,,	,,	,,	,,	20 ,,	2 ,,
,,	,,	,, ,,	4	,,	,,	,,	,,	17 ,,	8 ,,
,,	,,	,, ,,	$4\frac{1}{2}$	,,	,,	,,	,,	15 ,,	9 ,,
,,	,,	,, ,,	5	,,	,,	,,	,,	14 ,,	2 ,,

Or suppose you invest £10 a year at $2\frac{1}{2}$ per cent. compound interest, at the end of 9 years interest and principal will amount to £101 15s. 8d. That is, you will have paid £90 in 9 instalments and received £101 15s. 8d. for it. Now £10 a year is about 3s. $10\frac{1}{4}$d. a week; this sum is not too large to resolve to save if one has any desire for independence.

Great encouragement has in recent years been offered to the public for investing money by means of the Post Office Savings Bank, insurance societies, Government stocks, benefit clubs, and co-operative societies. Great care must be taken in deciding how money should be invested, remembering always that high interest means great risk, and offers generally bad security. Small investments can only safely secure a very moderate rate of interest, say from $2\frac{1}{2}$ to $3\frac{1}{2}$ per cent. Sometimes a tempting prospectus is sent out from some gold or diamond mining company; but it is well to avoid such for small investments. It is better to accept the lower rate of interest offered by the Government because of its security, the security being the nation's promise that all the money invested shall return to the depositor. Good men desiring the nation's welfare have started in many parts of the country what are termed 'Penny Banks,' that is a bank in which so small a sum as one penny could be saved.

Now there are many Post Office Penny Banks, which have this

great advantage that the savings collected may be directly paid into a Post Office Savings Bank, the Post Office supplying all necessary bank books and taking charge of the deposits.

The Post Office, too, really supplies the need of the humblest depositor now, for it issues a sheet free, upon which twelve spaces are marked, and in each of which a penny stamp can be fixed. When the twelve spaces are full the depositor can obtain a Post Office savings book and give up the sheet, which is entered in the books as one shilling deposited. Surely then no one with truth can say 'it is impossible to save anything out of my small earnings.' It is well known that we can all acquire the habit of saving, so that the earlier this habit is acquired the better it will be for the individual and the nation.

The interest allowed by the Government is at the rate of $2\frac{1}{2}$ per cent. per annum, and this without any risk. Amounts can be deposited or withdrawn at the will of the depositor. In course of time, as the amount deposited increases, the depositor may desire to purchase what is termed Government Stock or Consols, so as to provide either a life assurance or an annuity. If not less than £10 nor more than £25 be bought, 9d. only will be charged for commission. The charge for amounts exceeding £25 and not exceeding £50 is 1s. 3d.; exceeding £50 and not exceeding £75 is 1s. 9d.; and exceeding £75 and not exceeding £100 is 2s. 3d.

Interest is paid at the rate of $2\frac{1}{2}$ to $2\frac{3}{4}$ per cent. per annum. The amount of Government Stock which any one person can buy in a year must not exceed £100, and the total amount which can be held in this stock cannot exceed £300. Life assurance, that is, payment of a fixed sum at death, may be effected at many Post Offices by paying once for all a lump sum, the sum necessary being determined by the amount insured and age of the investor. Of course the younger the insurance is effected the less amount it will be necessary to pay for it. Life annuities, immediate or deferred, may also be purchased. By the payment of a sum down an annuity not exceeding £50 can be

secured for life. A woman's expectation of life being better than a man's, she has to pay a larger premium. Deferred life annuities or pensions are those which are payable at a particular age. A person wishing to purchase an annuity payable at the age of sixty may do so either by monthly or yearly payments. Thus a man between thirty and thirty-one years of age can by the payment of 8s. a month until he is sixty secure an allowance of £2 7s. 3d. a month when he reaches that age; and a woman under similar age and payment will receive £1 16s. 7d. a month. The annuities can be obtained under the returnable or non-returnable scale. Teachers, if they have no one depending upon them, should go on the non-returnable scale. On this scale the money paid in cannot be withdrawn, and if death supervene before the annuity is due the representatives receive none of it back. If the returnable scale be preferred, the money may be withdrawn, or in case of death the savings would be returned to the representatives, but of course a larger premium would have to be paid for it under this scale.

The 'Church Schoolmasters' and Schoolmistresses' Benevolent Institution' offers excellent provident annuities to church teachers. An immediate annuity not exceeding £40 may be granted by purchase to disabled teachers not less than fifty years of age whose total income at the time from all sources, including the annuity applied for, does not exceed £60 per annum.

The scale of charges for immediate or deferred annuities are prepared and issued by Government from time to time, but the Committee have power to grant a reduction of not more than one quarter from the amount named.

The following table is the last one issued by this excellent society:—

IMMEDIATE LIFE ANNUITIES.

(Reprinted from the Government Tables.)

Table showing the Sum to be paid to Government for an Immediate Life Annuity of £1, according to the Age and Sex of the Person upon whose Life the Annuity is to depend.

Age of the Person at the time of Purchase upon whose Life the Annuity is to depend.	Males. Money to be paid down in One Sum at the time of Purchase.	Females. Money to be paid down in One Sum at the time of Purchase.	Age of the Person at the time of Purchase upon whose life the Annuity is to depend.	Males. Money to be paid down in One Sum at the time of Purchase.	Females. Money to be paid down in One Sum at the time of Purchase.
	£ s. d.	£ s. d.		£ s. d.	£ s. d.
If 50 and under 51	14 19 11	16 11 9	If 60 and under 61	11 9 8	12 15 1
51 ,, 52	14 13 6	16 4 7	61 ,, 62	11 2 2	12 7 0
52 ,, 53	14 7 1	15 17 4	62 ,, 63	10 14 11	11 19 0
53 ,, 54	14 0 5	15 9 11	63 ,, 64	10 7 8	11 11 0
54 ,, 55	13 13 8	15 2 4	64 ,, 65	10 0 6	11 2 11
55 ,, 56	13 6 9	14 14 9	65 ,, 66	9 13 4	10 14 7
56 ,, 57	12 19 8	14 6 11	66 ,, 67	9 6 4	10 6 4
57 ,, 58	12 12 5	13 19 0	67 ,, 68	8 19 7	9 18 1
58 ,, 59	12 4 11	13 11 1	68 ,, 69	8 12 10	9 9 10
59 ,, 60	11 17 4	13 3 1	69 ,, 70	8 6 2	9 1 10

'The National Union of Teachers,' realizing the duty of teachers to provide for times of sickness, old age, and death, has founded a Provident Society, which is duly registered under the Friendly Societies' Act. The payments are based upon a sliding scale, each member paying according to his or her age and state of health when admitted. Hence the young members do not pay for the older ones, nor the strong and healthy for the weak and sick. The members may join for one or more benefits, such as sick-pay, pension, life assurance, or endowment, or they may join for all. The management expenses are very low, and none of the benefit funds can, under any circumstances, be touched for management expenses.

In many populous parishes there are provident dispensaries with a subscription of membership of one penny per week. For this amount the member is entitled to medical attendance and medicine. This is a very useful form of investment for working men, as without it few could afford in case of sickness to pay for a doctor's visits. In such cases many a disease becomes an aggravated one before medical advice is sought, and thus the wage-earner is laid aside for a long instead of a short period. Thriftless men will rely upon obtaining the services of the parish doctor, preferring the pauper dependence upon the rates to the manly spirit which provides for its own necessities.

As the population of towns increases so does the demand for houses in them, and as a consequence rents become very high. Happily the railway companies, to assist the working classes, run cheap workmen's trains morning and evening, and so carry many a weary toiler out of the crowded city to some pleasant suburb. Here more particularly the desire grows to become one's own landlord, and building societies have arisen to meet this want. These societies receive the weekly or monthly subscriptions of their members, and advance a sum sufficient to purchase or build a house. Those who do not wish to purchase a house receive a dividend and bonus on the sum of money invested in the society.

Benefit or friendly societies are maintained upon the co-operative principle, just as land and building societies are. A number of persons join together and agree to pay a fixed sum at stated times for certain benefits, such as pay when out of work or in sickness, or at death. The advantage of this plan is obvious; it saves a man falling into debt and keeps his home for him when he is unable to do it for himself.

The individual thus benefits by co-operation. Last winter, in one of the poorest districts of London, coal was retailed to the poor at the rate of 28s. per ton, though in the summer months the same quality coal was sold at 17s. per ton. Now had these poor persons been members of a co-operative stores, managed by themselves and for their own profit, how much better off would they have been!

This is a lesson which wants continual reiteration to make the poor fully realize it.

If they can be induced to save their money so that having ready cash they can at all times take advantage of any market, they would find themselves year by year able to provide for their families in comparative comfort. Of course there is always the danger in conducting a co-operative business of the manager being fraudulent, but if a good committee of management watch over it this can rarely occur. Lord Jersey in a small village on his Oxfordshire estate opened a co-operative stores for the sole benefit of his labourers. It is now entirely in their hands, and the profits accruing are annually divided amongst the members, who sometimes take up further shares in the stores or invest in some other society. They thus obtain the direct profit of all purchases, saving thereby between 10 and 20 per cent. on all purchases. It is to be desired that every one should discern between covetousness and thrift. The truly thrifty person is one who rightly provides for the inevitable 'rainy day.' Alas! 'most men work for the present, a few for the future, the wise only for both.'

Section VII.

HOW TO MAKE THE HOME PRETTY.

By MAY MORRIS.

HOW TO MAKE THE HOME PRETTY.

By May Morris.

I often hear the question asked by those about to set up house and anxious to make a pleasant home : 'How ought we to furnish our rooms?' Now, I am afraid it wants time and money to decorate a house with taste, and those who live hurried, hard-worked lives, necessarily give very little thought to the artistic possibilities of home life, and think themselves lucky if they manage to approach anywhere near to their ideal of its utilitarian side, which in many details differs from mine, but of that more anon. Making the best of badly-built and badly-fitted cheap modern houses is not a very grateful task, but it is one which those to whom these lines are dedicated are obliged to face. For unfortunately, now-a-days, when there is such a vast disparity between different incomes, advice to a leisured young couple whose life might be, if they would, a continual honeymoon, has to be of a different nature from that addressed to folk who can barely snatch a few days from their work for house-hunting, furnishing, merry-making, and all.

What I want to lay the greatest possible stress upon in these pages is my conviction that Beauty and Use go hand in hand, that an useless object cannot be beautiful, being meaningless; and that a beautiful thing is never without its use, never, as it were, misses its mark. To *know* unhesitatingly what is beautiful, to recognise the full value of beauty in homely and familiar objects of daily use—all this will no doubt come to us in time, with a happier and fuller life; meanwhile, let us consider how to make the best of what we have, how to choose and reject from wares within our reach, and see if we can lighten a little the monotony of our tasteless buildings.

Let us suppose, for example, that you have a certain very limited sum of money to spend on the arrangement of your

home, with a prospect of spending a little more as you can spare it now and then. The most reasonable plan is to purchase just what things are really necessary for the furnishing of your rooms; and then to find out by degrees what is further wanted for their completion, adding here a table, there a bookshelf or a new curtain, as the fancy strikes you; and thus your home will grow around you, become a part of you and of the story of your life, its gains and losses, its pleasures and troubles. For the poetry of life should be found at home and not abroad; and if it is worth while to live, it is worth while to make our intimate surroundings a pleasure to the senses and not a barren wilderness. There are rooms that express nothing and tell nothing of the life that goes on in them; oftenest the rooms of those among well-to-do folk who consider it 'bad form' to employ themselves seriously at home; or, if they do, rigorously conceal all traces of occupation from a visitor's eye. In big houses we have a reception-room, a breakfast-room, dining-room, smoking-room, music-room, library, and so forth—a room, in fact, for every small occupation of life, a room for almost every hour of the day. Poor people are at any rate saved from such cumbrous forms of life, and with them a living-room *is* a living-room, where they work, play and eat alike, and too often sleep too, one may sorrowfully add. I hope you do not think I speak in favour of so over-compact an arrangement, but a good deal is possible between the two extremes. Listen, now, to the description of a prosperous farmer's house in Norway; though written to-day by Björnsen, the well-known novelist and poet, it might as well refer to the interior of an ordinary house in mediæval England:—

'Arne put down his saw and went into the kitchen; there white sand was spread upon the floor, and finely cut juniper leaves strewed over it; on the walls glittered copper kettles, and crockery stood in rows.'

He asks to see the bonder or householder, and is directed to the sitting-room.

'It was cheerful in there, and brightly painted; the ceiling was decorated with many roses, the cupboards were red, with the owner's name in black, the bedstead was also red, but bordered with blue stripes.' The big bed of painted wood with all its panoply of hangings of embroidery or tapestry was a great feature in mediæval domestic furnishing; still I am not recommending it as a feature for a modern sitting-room. But the few words of description give an agreeable glimpse of bright colour, the expression of a hopeful life, and the pride of the Norwegian farmer in painting and decorating his house, however naive and simple those roses on the ceiling and the red and black cupboards might be.

Now with regard to a few practical hints on furnishing for a modest household: we cannot go through every detail of decorating and fitting, but I propose to glance at one room at least, and see what can be made of it. It is not necessary to say much here about the English sitting-room we read of in novels, 'replete with every comfort and convenience.' The comfort and convenience is often found to consist of many superfluous yards of carpet and curtain, low easy-chairs into which the unwary fall as into a trap of feather-bed and cushions, a full half more furniture than is needed, a dismal twilight, and a certain dusty stuffiness and want of ventilation which is caused by the fear of *draughts*, those bugbears of the English housewife. So much for a certain ideal of home-comfort which has been greatly criticised of late years, and which one is glad to see gradually giving way to a healthier ideal, by which light and air are allowed more play, and superfluous furniture is banished.

I will presume that the room at which we are looking is in a house in London or suburban London, or in some other large and smoky town, closely surrounded by other dwellings, all more or less in need of more air and light than they get. I will also presume that there is a certain want of space in your apartments or house, and that sitting-room and dining-

room are one. I know that to many people this seems nothing short of a horror, and every effort and squeezing of bedroom space would be attempted to secure the necessary parlour or drawing-room; still many of us endure the privation with equanimity. To begin with, let us bear in mind that light and air being the great want among town-dwellers, to make the most of them every other consideration should be more or less subordinated. They have to be borne in mind in choosing wall-papers, selecting paint, arranging curtains, carpets, chairs and what not. If your sitting-room happens to be light and airy, facing the south, and is not blocked up by opposite houses, your trouble will be the less; but I have to suppose the contrary, as we are considering how to make the best of what we have. In fact, I have to suppose a good many things: to begin with, that you have taken rooms where nothing is prepared for you by the landlord; that, besides furnishing, you are going to direct and choose paper and paint, and even whitewash of ceiling (which shall be a soft white devoid of any suspicion of blue). If not allowed this amount of 'make believe,' I should have little to write about, for what can one say of rooms where the wall-decoration is already cheaply and badly done to pattern, similar to rooms in the houses to right and to left? Those who read these lines must take from them what they can and reject what they know to be impracticable in their own cases.

The wall-covering, then, has first to be thought of; and, as our room is a very simple one, we have only a choice between an inexpensive machine-made wall-paper and a plain colouring or *distemper*. Of the two, I incline towards the former; for, unless it is proposed to cover up wall-space afterwards with a profusion of pictures or drawings, or otherwise break the space, one's eye tires of the broad flat display of colour, unbroken by folds, variety of texture, or any other play of light and shade. Still, the simpler the arrangement of wall-decoration, with the very humble materials at our command, the

better. The plan of dividing a wall into three parts, with dado below the principal space, and freize above it, is very handsome when treated with rich materials; panelled dado, hangings above, and plaster or painted freize above that; but when mimicked in imitation wood-work, and by merely placing one paper above another of a different design, the result is pretentious and fussy without being effective. If for any reason distemper is chosen for your wall, the colour must be chosen with great care, otherwise you may find yourself burthened with some repulsive shade, which the local decorator in his anxiety to please will call for your benefit an 'art-colour.' As no brilliancy of tone can be obtained by this method, dark colours should be cautiously chosen, or even avoided; and really the safest and most inoffensive shade is a light silvery yet not *cold* green, if you can but hit it off. I have no great affection for upholstered 'nooks' and gimcracks that savour of the boudoir; but a simple way of breaking a bare wall is to fit up one corner of the room with a long low divan consisting of a plain wooden frame strung across with webbing (it can be speedily made by any one with a taste for carpentering), on which is laid a firm mattrass covered with stuff or Indian matting, or, better still, a stout washing chintz. The wall above and round the corner is hung with chintz or what not, to harmonize with the colour of the wall. The divan should be quite broad and low, otherwise it loses its character, and there should be plenty of bolsters and cushions.

I have said above that it is more advisable to furnish as slightly as your daily needs will allow on first setting-up house, and find out what you further want and collect things about as you go on; but if you go into rooms which have to be completely renovated (as I hope you may), you will, as a matter of course, consider a general scheme of colour suitable to each, and always bear the same in mind in collecting and arranging your household goods. Let us for instance suppose your living-room to be rather dismal and that we are 'fur-

nishing throughout,' and want it to be bright and homely, so that you shall regret leaving it for the outer world, and your steps shall quicken on returning to it from the sombre streets.

I would have all the woodwork of this room painted white of an ivory tinge; the paper, which shall be of one colour only, as it is to be an inexpensive one, shall be rather a small design, but not minutely so, printed in a clear, full, rather light red on a white ground; and thus we have two important things settled. Now, the floor of an ordinary town house will certainly be a poor piece of workmanship, and you had better at once stain it a dark brown; if the boards are very rough and bad, *paint* it brown, and polish it after it is thoroughly dry. Any cracks and holes may have to be filled up first with what carpenters call *knotting*. If your boards are stained all over, you will be saved the eternal discomfort of scrubbing—England being damp enough already. A floor carpeted into every corner is an abomination and a dust trap; if you have only a little rug or two about, you can afford better ones, if you know where to go for them. It is safest, if not sure of your judgment, to choose among Eastern rugs at some big firm with a reputation for such things, where, unless you are particularly unlucky, you will find odds and ends of fairly good colour which will probably tone well with your room. Having chosen for this a pale red paper on a white ground, rugs in which a dark blue is the ruling colour will form a rich and quiet contrast. There will be other colours in the rugs if they are from the East—a little orange most likely, pale turquoise-blue, perhaps green—none of which will clash with but rather help out your colouring. Reject anything with magenta or coarse purple in it: the skill and fame of Eastern carpet-weaving is becoming a rapidly waning tradition merely, and crude and tasteless tones often take the place of the magic richness of colour which we associate with oriental art.

A word as to how to choose may not be out of place here.

Unless you can afford to go for stuffs and carpets to a furnishing firm that has a well-established reputation for selling beautiful goods, buy nothing, as a rule, in an ordinary shop that the salesman presses on you as 'artistic;' content yourself with the utmost simplicity, choosing rather plain materials than patterned ones (although of course patterned stuffs are both richer in effect and more serviceable when you can find them good) unless the designs are extremely simple and inobtrusive. Avoid muddy and depressing colours, dirty greens and browns and mustard yellows, washed-out purples of the 'crushed-strawberry' hue: a fairly good dark blue can usually be obtained now in most materials, and is at once the most serviceable and pleasantest colour to live with; the same may be said of green, but the messy dyeing used to obtain the greens of ordinary commerce has the curious result that materials so dyed look fairly well by day, but at night go a livid and indescribable colour, most unpleasing to behold. The blue of commerce, by-the-bye, often looks dirty purple by artificial light.

I suppose in this land of constant winter we must curtain our windows—in winter at least—for I consider curtains in summer a concession to human weakness; and if you find that you need them, please make them of chintz, unlined, or stout cotton or muslin, easily shaken and easily removed for washing and mending. In winter something heavier will be needed; for modern houses, unless luxuriously built, are badly finished and let in the cold. The quickest and perhaps the least costly way of making curtains is to choose some quite heavy woollen material, at a fair price, that will need no lining or making up with headings and fringes, which latter decoration, unless the veriest rubbish, is always costly. A dark indigo blue, figured, if possible, light and dark blue, will go with the room we are furnishing, and such a curtain would not need to be full, nor to have any making up beyond a plain hem top and bottom. Curtain-poles need not be elaborate; plain iron rods bought

by the foot, laid on little screw brackets, answer the purpose; this constitutes an unobtrusive and sufficient curtain-fitting, but if something of less Spartan severity is wanted, let rods and fittings be of brass instead of iron. Such simple fitting is all that is needed, and the clumsy and costly brackets and mouldings of former days may be banished for evermore. Your curtains might also be of coloured serge, or again of Bolton sheeting, though I don't strongly recommend the latter material except on the score of expense. If in your household there is leisure for embroidery, *white* sheeting covered with a bold trailing network of curves in thick blue and red and green worsted-work would make charming winter-curtains for this room. If your house is in a narrow street and you are sensitive to being overlooked, I suppose you must have half-blinds of printed muslin—in the bedrooms at any rate. But avoid it if you can in the sitting-room; there is no harm in your opposite neighbour getting a glimpse of your life now and again, and when night comes you can draw the curtains and shut out the scrutiny of strange eyes. But let the curtains always be well drawn back during the day; we will attempt to emulate the freshness and frankness of the open air rather than affect a half-light, suggestive of the boudoir of a *demi-mondaine*, or of Mrs. Skewton with her dying babble of 'rose-coloured curtains for doctors.'

Before we leave the subject of colour, let me advise you not to arrange the colouring of your room *en suite*, for nothing is more wearisome than an 'all blue' or 'all red' or 'all yellow' room; colours do not necessarily jar if in strong contrast, though I admit that such an arrangement requires more trouble and thought. Again, the colour of a sitting-room will, or ought to, depend upon the temperament of its dwellers, as colour-idiosyncrasies are very marked in many people and should be considered. If you have a painful aversion to red or any warm colour, your housemate will rather choose cool greens or blues for your eyes to rest on; and the amiable strife

that arises from each being desirous to yield to the taste of the other, will add an additional zest to the business in hand.

Furniture will not occupy my attention long, for two reasons: first, because being necessarily an expensive item in house-decoration, what you buy will depend entirely on what you can afford; next, because there are certain essential things that you cannot do without. Chairs, tables, sofa, and so forth—let all be of the simplest and plainest, and as strong and solid as your purse will buy. Your principal table should be as large as the room will comfortably afford, and substantial enough to be really *serviceable* for all purposes. Well-made second-hand furniture can be picked up at scarcely a higher price than paid for gimcrack things made to sell and not to last; so if you have time to look round a little and ferret in shabby old shops, buy what you need in this way. Really pretty old chairs of the last century (sometimes by well-known designers) are often to be met with, and a couple of leaves of a mahogany table of our great grandmother's days make a fair table. I prefer, however, a plain oak or a plain deal board screwed to legs or trestles, all of which can be made by a friendly carpenter, who will soon get used to your unusual demands, and show a condescending interest in the little inventive arrangements that will occur to you. (If he does not, go to someone else, for an unsympathetic carpenter is more depressing than one who has not tried would believe.) Little bits of furniture must be left to your taste; but don't crowd your room with trifles, and renounce any idea of having the traditional upholstered armchair with springs and castors. In badly made chairs of this sort the springs come to bits at once, and the well-made ones are far beyond our means. If you have a talent for finding old things and renovating them, you might get an old-fashioned high chair with ears—they are very comfortable—and restuff and cover it if necessary. This, with a few plain rush-bottomed chairs and perhaps a low cane chair or two (with cushions and petticoats of chintz to keep ladies' skirts from catching in the

cane), will be all you want to sit on; but you should have a little sofa or the divan mentioned above. The latter is more comfortable than a short sofa, and I hope you understand what it is like. Of course, it can be put together any shape and size you please. The hanging on the wall above can be dispensed with, but it makes the corner more complete, and if your walls are distempered and very bare, will help to furnish the place. It needs no arrangement of rail or rod, and can be hung on three or four hooks driven into the wall.

I hope you will consent to have a plain painted deal dresser, instead of a sideboard or chiffonier, to hold your china and such things; such an arrangement would completely furnish one side of your room, and you could keep on it all the odds and ends of crockery wanted for daily use. If kitchen and sitting-room are one, such a dresser is a matter-of-course, and very nice it looks. I don't think a plain deal dresser of two or three shelves, with broad ledge and roomy cupboards below, would cost more than the heavy and tasteless sideboards and chiffoniers so often met with. I am led from this to consider the nature of ornaments for our parlour. Ornaments consist of pots, bowls, dishes, candlesticks, boxes, and so on; in other words, the same articles as we have in daily use, only of a better quality and professing more or less to be 'works of art.' These things are usually placed on and above the mantlepiece, in corner cupboards, or plastered over the wall—anywhere so that the places are inaccessible enough to show that the objects are meant for ornament and not for use.

Now, I would have none of such things, for your plates, dishes and bowls of daily use should be your ornaments; if *they* are ugly, do not think to mend matters by hanging other plates and dishes about the walls. A room decorated by minor objects laid out for *use* and not for display's sake, has, to my thinking, an agreeable and sufficient decoration. The common coarse Japanese and other Eastern crockery ware is almost as cheap as, and is sometimes cheaper than, ordinary china;

and those who are able to visit large shops where such things are sold by the thousand, cannot do better than obtain the few things they want from among such ware, which is pleasant in colour though very rough, ornamental enough for our dresser, and not too delicate for daily use. Let all your ornaments be costly *sèvres* shepherdesses in their vulgar and ridiculous costume, or the more lowly china pug-dog with a black nose and a blue ribbon round his fat neck, and the theory of ornament for ornament's sake is reduced to an absurdity obvious to any one. As it is not always equally clearly shown, we will give the reverse side of the picture in our typical parlour, and show that the beauties of useful things lie in their very usefulness, and we will also determine that they shall not be ugly in themselves if we can help it. For you will not think that I assert nothing useful can be ugly; in an age like this, when wares are hurriedly and thoughtlessly turned out by machinery, it is oftener a surprise that they have any vestige of sightliness about them; on the other hand, an article which professes to be a work of art and yet has no ostensible use as an implement or some household utensil, is quite meaningless and loses half its value. (I am speaking here of the lesser arts: painting and sculpture—though now too severely divorced from the minor arts—having of course their special and peculiar value quite apart from any consideration of use.) The *sèvres* shepherdess and pug-dog are cases in point: no one can in his heart of hearts really admire the shepherdess, nor would want to have her if she were not enormously costly—a true representative of snobbery. The pug-dog style of ornament is only less absurd because unostentatious, and even from association with pleasant cottages and friendly greetings appeals in its simple art to our affections.

I have said nothing about the chimneypiece and fireplace in our parlour, but am hoping that you will not feel impelled to hang a mantel border from the former to act as a dust and soot

trap; leaving it bare, rather, of knick-knacks or anything except the necessary tapers, bowls for tobacco-ash, and a pot or two of flowers. In summer, if you are very sensitive to draughts, you might hang a curtain across the fireplace, otherwise put a pot on the hearth with green boughs or flowers for special occasions, and for every day leave it alone with the fire laid ready for lighting. We all know and have suffered from the old custom of dispensing with fires at a certain date in April, and lighting them again at a certain date in September; it forms quite a solemn rite. In the bitter days of summer between these dates we may amuse ourselves by looking at the cold grate decorated with shavings made precious by silver and gold tinsel laid on it, or at the wonderful pink and green paper cascades that in the days of childhood, with its love for crude colour, were secretly held to be the most beautiful and fairylike things in the whole house. We are of course avoiding such vagaries, and our little room is beginning to look tolerably inhabitable, with its white paint and light-red paper, its blue chintz or blue stuff curtains, and its plain dresser furnished with blue and white and red crockery all well dusted and ready for use. At night, with the fire burning, the curtains drawn and lamp alight, and the inmates and their friends assembled round the hearth, *le comfort Anglais* may indeed be missing, but in its place we have a wholesome freshness of surroundings, simplicity and sufficient luxury, purity of colour together with a certain touch of austerity which is the reverse of the enervating and unrestrained luxury of a rich and tasteless room where pleasure is hunted to the death, and serious thoughts and works banished.

The two bugbears of tasteful furnishing are *gentility* and what the French call *le comfort Anglais*—'English comfort,' expressively leaving the latter word in its original language as untranslateable. For gentility implies bowing to certain rules of conduct, of living, of directing the household, and so forth; Messieurs Brown, Jones, and Robinson copy

each other, and plain Jack and Jill copy *them* in their respectful way. This timidity and want of individuality is enough to frighten domestic art from our houses for ever and ever, for to have reasonable and pleasant homes we must know what we want and determine to have it, without reference to the opinion of our fellows. 'English comfort' I have perhaps too cavalierly condemned by implication throughout these pages; but its ruling feature being *stuffiness*, I do not feel inclined to retract anything, and will leave the over-furnished and over-padded room to find its own apologist.

I have hinted above at the difficulty of making the best of rooms already painted and otherwise prepared for their inmates by a careless builder or agent. You must bear in mind that the room we have been speaking about is decorated in the simplest and plainest manner, and in a manner that many middle-class people would condemn as poverty-stricken, and yet, you see, we speak of polished floors, Eastern rugs, gay chintzes, and even, if we can manage it, embroidered hangings. The reason of this mixture of simplicity and richness is, that we expend our money in articles which have decorative value in colour and form and which are also useful, but neither showy nor purse-proud. There is no springy sofa nor deep easy chair, no mirror on the wall, and no handsome sideboard, and our substitutes for sofa and sideboard are certainly very humble. But wall-papers which are better than a mere film of mashy smeared paper that scarcely bears hanging are not cheap, even though I expect you to get *machine-printed* papers, those which are *hand-printed* being outside our possibilities on the score of cost; curtains of chintz, serge or what not, all cost something; and, in short, it is impossible to furnish a room to look really completely decorated (not merely *furnished*) without spending money on it.

Those who read these pages to whom it all sounds impossible nonsense owing to the expenditure, I beg them to take what hints they can from my jottings of experience. Let

them bear in mind that at any rate I distinctly discourage admiration and imitation of the purse-proud ideal of comfort and display, which is as tasteless and dead a thing as can well be imagined; yet which, though dead, hangs about the air in a discomforting way, and makes us sometimes doubt our own common-sense, that, untampered with, leads us to better things.

If your walls are ugly or discoloured they must be covered here and there with bookshelves, with prints and photographs —the frames made of any wood to be had, sand-papered and painted black or what colour seems best (sometimes a white frame is suitable). I am sure you can still have your curtained corner, if you fancy the idea; if it were only a simple flowered cotton it would help to break the wall-space, and surely a sofa is more needed in the home of a hard working-man than anywhere else. At least let every corner be free from dust and from any superfluous rubbish or useless ornaments, the windows often open, and a few pence spared now and then for flowers for the table, unless you are a country dweller and can pluck from the generous fields and hedgerows. What I have said about cheap Eastern crockery and such small objects, always holds good, and surely no housewife will wish to keep about her much superfluity of china to be dusted often, adding to her daily labours. There are many makeshifts I might have suggested to serve instead of something unattainable, but makeshifts are pushed before your eyes every day in every shop, and if, for instance, you can't get the Eastern rug for your floor, you will buy a strip of Brussels carpet or of matting and make the best of it; but it needs no solemn advice to do this, for necessity and common-sense impel you to it. Each must think for himself and decorate his home according to his needs, his tastes, his limitations of purse; for there is no other royal road to education of taste in such matters except to bear in mind the value of colour, the beauty and dignity of simplicity, and the beauty of use.

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